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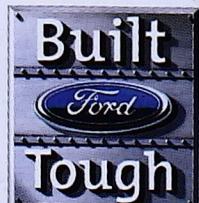
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JUNE 1999

VIPER
VS.
VETTE

Popular Mechanics

THE MACHINES OF

STAR WARS

EPISODE I

THE PHANTOM MENACE

Beyond Your Wildest Imagination!
Exclusive Inside Look At The
Fantastic Cyberworld Of
George Lucas's Latest
Blockbuster



Popular Mechanics

PRINTED IN U.S.A.

June

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Science

STAR WARS EPISODE I THE PHANTOM MENACE

The Machines Of Star Wars

► George Lucas gives you an exclusive peek at the mind-boggling space- and landcraft that appear in "Star Wars: Episode I—The Phantom Menace." We're also giving away a great collector "Star Wars" poster, bound right into this June issue. Cutaway views reveal the inner workings of these fantastic creations. www.popularmechanics.com/popmech/hot/SWP.html

Outdoors

Ride The Wind

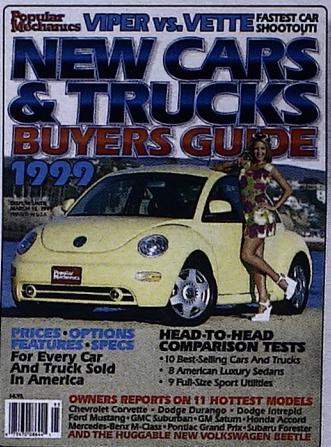
► When Cannondale bicycle makers wanted to forge the most perfect union of man and machine without bionic surgery, they turned to the wind tunnel. Here's how they got the aero advantage in racing. www.popularmechanics.com/popmech/sci/9808STSSP.html

Technology

The PC You Wear

► IBM whisks you into its secret labs for an inside look at the PCs of tomorrow. One of the most impressive developments is a lightweight, wearable PC that's being called the Walkman of personal computing. Here's the complete story. www.popularmechanics.com/popmech/elect/9812EFCOAP.html

Automotive



Our New Cars & Trucks Buyers Guide

► Here's all you need to know about buying a new car or truck. The information includes features, specs, prices and comparison tests, as well as PM's exclusive owners reports. www.popularmechanics.com/popmech/auto3/99CBG/99CBGP.html

Home Improvement

Riding Mowers

► Why walk when you can ride? Our test of eight riding mowers, with prices ranging from \$860 to \$3700, shows you what you get for your money and which mower is right for you. www.popularmechanics.com/popmech/homei/9807HIGDCP.html



My Pentax IQZoom 160



This is the five-point
passive autofocus system
that measured how tall Omar
was, chose the optimum
setting, and captured every
feather in perfect detail.

This is the easy-to-read
dial that let me quickly pick
the daylight-sync shooting
mode so not a single shadow
crossed Omar's kissable mug.

[My Photo]

This is my bird's-eye
view of Omar —
"King of the Petting Zoo"
as he was eyeing my
son Toby for lunch.

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Editor's Notes

Star Wars And Star Students

► It is quite possibly

the most anticipated movie of all time. Film maker George Lucas has spent more than \$100 million out of his own pocket to make



PHOTO BY JAMES A. SUGAR

Science editor Jim Wilson and his new pal, a "Star Wars" battle droid.

"Star Wars: Episode I—The Phantom Menace." There is no question this latest "Star Wars" film will be another blockbuster. The only question is how big a blockbuster. Lucas and his company have created a whole world entirely inside computers to make this film. In fact, the only actual objects in the film are the humans.

Everything else you see is virtual, existing only inside a computer. Lucas has a policy of never creating humans via computer. Other than that, technology rules. Lucas says that the technology used to make this film, compared to the technology used 22 years ago to make the original "Star Wars," is a technology leap akin to that from silent films to talkies. To find out just how far filmmaking technology has come in 22 years, we dispatched science editor Jim Wilson to Lucas's Skywalker Ranch magic kingdom, 60 miles north of San Francisco. You just can't walk into this place. There are no tours and everything on the third floor is top secret. But George Lucas happens to be a fan of POPULAR MECHANICS. So Wilson was treated royally and given almost total access to the secret world of Lucasfilm. His exciting cover story begins on page 76. Read it. Enjoy it. Then go see the film. ... Those of you who read us on a regular basis know that we're a supporter of McPherson College in McPherson, Kan., through our relationship with PM's newest contributing editor, Jay Leno. Jay has been an admirer

and supporter of the four-year private school, which was founded in 1887, because of its unique auto restoration program. Because of its unusual curriculum, which both Jay Leno and we think is important to the youth of America, we've established the Jay Leno/POPULAR MECHANICS Scholarship at McPherson. Recently, I had the pleasure of visiting McPherson College and presenting a check for the first year's scholarship funding to McPherson president Gary Dill. I also met a fine young man, our first scholarship winner, Preston Switzer of Taylor, Neb. Early in his senior year at Loup County Public School in Taylor, Preston decided he'd like to pursue a career in auto restoration. He had no idea where he could go to get this type of education. He didn't want to be a mechanic or do bodywork on newer cars. He wanted to restore antiques, classics and special interest collector cars. A friend told Preston about McPherson and he and his parents went for a visit. The campus was beautiful but when



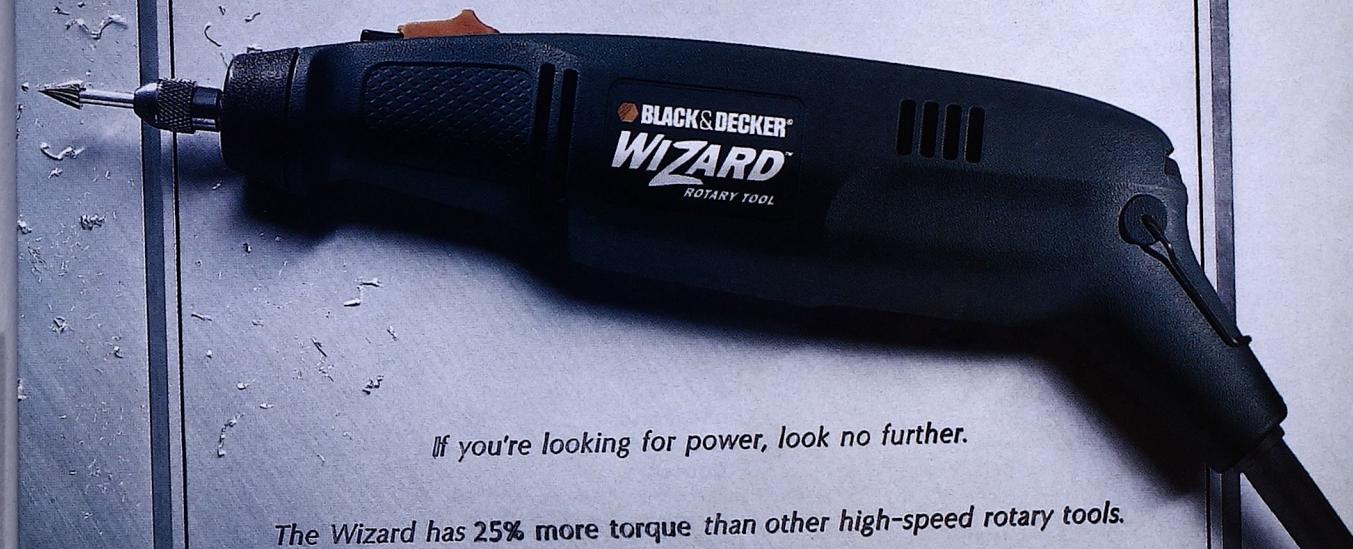
PHOTO BY DARREN LIBBY/PHOTOGRAPHY

Gary Dill, president of McPherson College, center, and Preston Switzer, right. they walked through the doors, that was it. They were sold. There was no doubt that this was where Preston wanted to further his education. If you or someone you know wants further information on McPherson, contact the school by writing the College Admissions Office, McPherson College, 1600 E. Euclid St., P.O. Box 1402, McPherson, KS 67460. You can also call 800-365-7402 or 316-241-0731, or visit the school's Web site: www.mcpherson.edu. Till next time.

Joe Oldham

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To log in, simply launch your browser software (we recommend using Netscape 3.0) and open the following URL: <http://popularmechanics.com>. We are also part of Hearst's full-service information network, HomeArts. Check it out at <http://homearts.com>.

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Editorial Administration

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Reader Information Services

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Editorial Offices

224 W. 57th St., New York, NY 10019
212/649-2000

Publisher Jay McGill

Associate Publisher/Marketing Director William E. Congdon
Associate Publisher/Advertising Director Gregg R. Hano

Group General Mgr. Bruce A. Mitnick
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Promotion Manager Elizabeth Galiardo
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212/649-3164
Assistant to the Publisher Lori Coccia
212/649-3078

Marketing Coordinator Joan Ferguson
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212/649-3080

Advertising Sales Offices

New York

224 W. 57th St., New York, NY 10019
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Chicago

1 S. Wacker Dr., Chicago, IL 60606
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312/984-5195
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312/984-5191

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415/778-6486

Atlanta

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Manager Daniel F. Kellner

972/529-9687

Direct Response

Rosemary Cockburn
212/649-3136
Matthew Friedman

212/649-3218

Classified

Manager Kevin Bristow

708/352-8304

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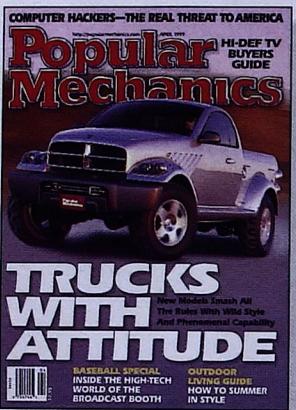
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Letters

Trucks With Attitude



The new Dodge Power Wagon concept truck is incredible! My biggest fear is that Dodge will do what every other manufacturer does with concept cars—tune down its radical styling so that it sits well with the general public. Please, no! Sell it to us the way it is, tomorrow!

JAY GREENER
VIA INTERNET

Under The Gun

As a law-abiding gun owner from Massachusetts, I would like to thank you for printing the letter titled "Gun Geek." It was refreshing to see such a no-nonsense reply to such a nonsense-filled letter.

ED LEFAVE
VIA INTERNET

I want to compliment you on the answer to the letter complaining about gun articles. Your answer hit the nail on the head and couldn't have been any clearer. I'm glad that your magazine has the guts to stand up to people like that. I am an NRA Life Member and a police officer of 28 years. I guess I'm from the old school and believe that every person is responsible for his or her own actions. Guns, like any other object, are dangerous if you don't use them responsibly.

CAPT. SID RIEFF
VIA INTERNET

I just had to drop a line and express my appreciation. Your response to the letter sent by Mr. Miller restored my hope that there are still thinking people on the planet. Your reply was direct

and to the point. It is beyond my comprehension how people can demonize an inanimate object.

MIKE COTTON
VIA INTERNET

Thanks for a direct and to-the-point response to Mr. Miller's letter on banning guns. It's good to see editors stand up for what they believe is right. As a local NRA rep, I try to get people to understand that it's not just one amendment that's important. It's the fact that if one goes, all our freedom is lost. That's something that can never be allowed to happen.

STEPHEN PARRIS
VIA INTERNET

Thank you! It is really great to see a publication stand up for the rights of all U.S. citizens. I think Mr. Miller surely

missed the point of your magazine. You report on all technical developments. Although I am a gun owner, I also see the issue as that of freedom of speech.

PAUL BAXTER
VIA INTERNET

I was greatly pleased with your response to Mr. Miller's letter. It was gratifying to see an editor strongly backing the Second Amendment.

JOHN BECHTOL
VIA INTERNET

I'm canceling my subscription to PM. Your answer to a simple, valid question concerning articles about guns was disgusting. With answers like that, the only people reading your magazine will be the militia and Ted Kaczynski.

GERARDO GARCIA
VIA INTERNET

Reader Project Of The Month

I have just completed a home workshop project I hope is worthy of coverage in your magazine. I have a large piece of rural property and was looking for a way to improve the efficiency of my mower. I have replaced the 18-hp air-cooled Briggs and Stratton engine in my riding mower with a 60-hp Chevrolet Sprint engine. When I took measurements of the



Sprint motor I found that they were very close to the Briggs and Stratton engine's and voilà—the solution to a quieter, more powerful mower was at hand.

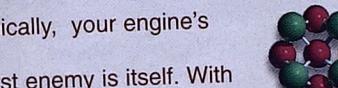
ED KIDERA
BRISTOL, WI

If your project is chosen as Reader Project Of The Month, you will receive a selection of Popular Mechanics/Wal-Mart tools as a token of our appreciation for sharing your project with us. For your project to be considered, please send a clear, color photo and brief description to: Reader Project Of The Month, Popular Mechanics, 224 W. 57th St., New York, NY 10019.

Letters are subject to editing for length, style and format.

HARMFUL PARTICLES CAN RUN, BUT THEY CAN'T HIDE.

Ironically, your engine's worst enemy is itself. With every stroke, an internal combustion engine spews



other by-products of combustion, such as oxidized fuel fragments, soot, or any



harmful particles. Whether they're

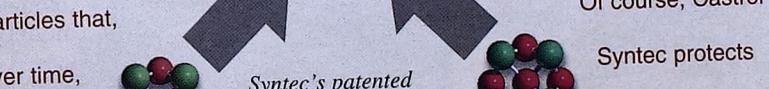
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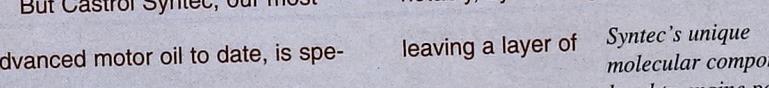
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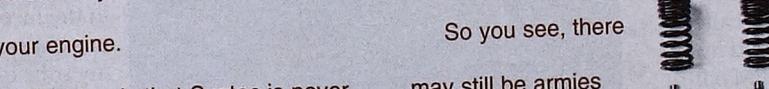
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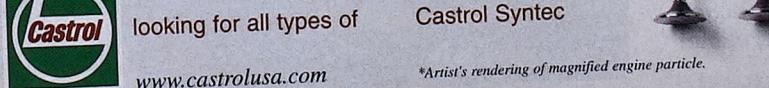
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hunting them down, they don't stand a chance.

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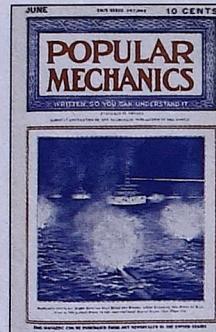
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FULL SYNTHETIC MOTOR OIL

*Artist's rendering of magnified engine particle.

Time Machine

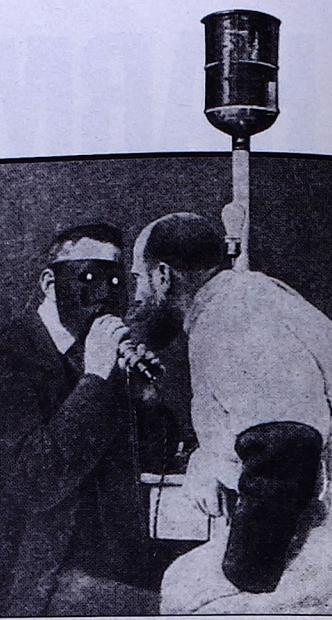
90

Years Ago:
June 1909



See Shells

Battleships using searchlights to pick up approaching torpedo boats at night were toyin with suicide since they plainly marked themselves as targets. The Germans were experimenting with acetylene shells that were fired as far as 6 miles with a special gun. When the shell hit the sea, water combined with the shell's carbide to form acetylene gas, which ignited and burned with a light of 3000 candlepower. This illuminated enemy targets without compromising the battleship.



The Eyes Have It

No, this isn't a man eating electric light fixtures. It's a patient having the back of his eyes examined. The device, known as the opthalmidaphanoscope, consisted of an 80-candlepower lamp with a self-contained tube that provided water cooling. The patient placed the bulb as far back in his mouth as possible and against the upper wall of the buccal cavity. The doctor viewed the pupil of the eye from the front, where the highly illumi-

nated retina was plainly visible, allowing him to diagnose possible problems.

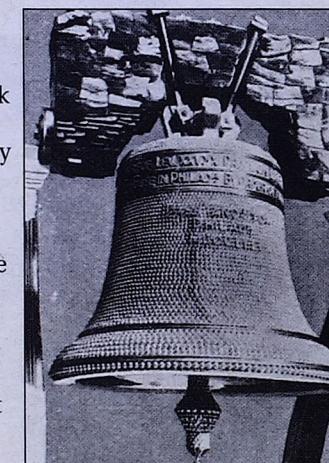
60

Years Ago:
June 1939



'Choo Fly

Pride of the American railroads, the world's largest steam locomotive, designed by Raymond Loewy, was put on display at the New York World's Fair. Weighing more than 1 million pounds, the engine developed 6500 hp at 100 mph. Destined to pull one of the crack passenger trains of the Pennsylvania Railroad after its stint in the fair, the engine was expected to smash the 127-mph record set by a Pennsylvania engine pulling the Broadway Limited in 1905.



Pearls Before Pearl

With the horror of Pearl Harbor still 30 months into the future, the New York World's Fair whirred away in oblivious innocence. One exhibitor to the fair was an unnamed Japanese company that brought over, interestingly

enough, a model of the historically famous Liberty Bell that reportedly cost \$1 million to build. Standing 1 ft. 2 in. high, and measuring 1 ft. 3 in. in diameter, the model contained 11,600 pearls, 366 diamonds and more than 26 pounds of silver.

30

Years Ago:
June 1969



Try And Stop Me

Swamps and snow were no obstacles to OMC's planned new ATV. Powered by a 25-hp OMC engine and a pair of hydrostatic transmissions controlling the tanklike rubber treads, the Secret Green Machine, as it was called, couldn't be stopped no matter what the PM editor threw at it. The OMC ATV could climb up a steeply inclined loose sand dune and over tree stumps—and even travel over water. The machine's projected price was a steep (for the time) \$2300.

Illuminating History

It was one of World War II's supreme moments. U.S. warplanes had hit the Imperial Fleet and, now low on fuel,



were returning to their carriers and trying to find them in pitch darkness. PM captured the full drama of the historic moment when Rear Adm. J.J. "Jocko" Clark made a remarkable decision in the face of possible enemy subs in the area and gambled the fate of his entire task group to help the pilots: Damn the submarines! Turn on the lights!

ORGANIZE YOUR

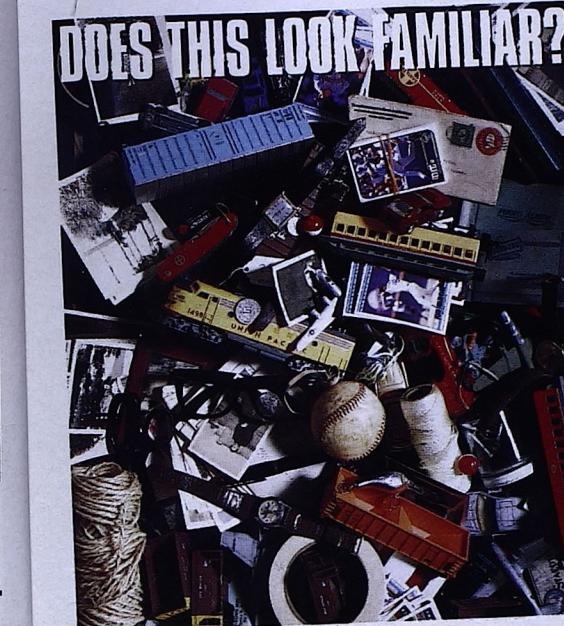
COLLECTIBLES

TURN YOUR COLLECTION INTO SOMETHING SPECIAL

What's the difference between collecting and just gathering a bunch of stuff? A collector who's passionate about his hobby can walk into a room and appreciate the value and depth of a collection, while to the untrained eye it may just look like a bunch of stuff, a mess. Whether it's memorabilia from your favorite movie or antique timepieces, a Brother P-Touch Electronic Labeling System can turn your collection into something others will admire as much as you do.

For example, a lot of people say they have a baseball card collection, but what they really have is a pile of cards. Even if they were to take those cards and arrange them into a neat display case with the extra cards carefully cataloged and stored close by, it still wouldn't really be a collection.

Why not? If someone else walked into the room, would that person know that the left side of the display box held all the batting champions for the last decade and the right side all the Cy Young Award winners? Would they know that the cards were separated into American League and National League by year? Probably not, unless the display box was labeled as such.



When you go to an auto museum or a gun show, the items aren't just scattered about the room. They're arranged, organized, and clearly marked. That's what makes them a collection. A P-Touch System is the easiest way to complete your collection. Labeling has another benefit, too. It helps you decide what qualifies as collectible, because if it's not worth identifying, it's probably not worth keeping.



1957 DIESEL ENGINE

IT'S EASY TO USE
With a P-Touch Electronic Labeler, organizing your collection is a snap; just pop in a tape cassette, type in your data, and out comes a printed, durable label that's virtually waterproof, smudge-proof and fade-proof. Peel off the backing and stick it in place — it'll stay put

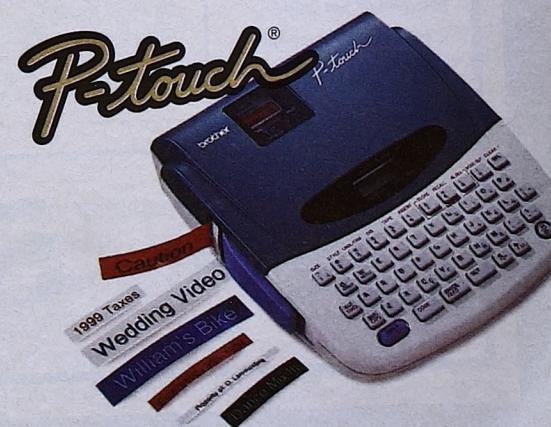
without crinkling or curling. P-Touch labels can be whatever length you like and anywhere from 1/4 inch to 1-1/2 inches wide, depending on the model used. Tapes come in a wide variety of colors and can be printed in different type styles, so the labels complement the items on display.



brother

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Brother P-Touch Electronic Labeling Systems can be purchased at most office equipment retailers. For more information, visit Brother's website at www.brother.com

**GRANTED, BUILDING A HOUSE ALONE CAN BE TOUGH.
BUT WHAT IF YOU WERE 9 FT. TALLER?**

<http://popularmechanics.com>

Technology Watch

Aviation • Computers • Energy
Environment • Medicine • Military
Robotics • Space • Transportation



Terrorist Tripper

A new way of arranging old construction materials may protect U.S. embassies in hostile Third World countries.

Researchers from the Lawrence Livermore National Laboratory (LLNL) have successfully tested a low-cost "terrorist vehicle barrier" at the Department of Energy's testing grounds in Nevada. The prototype consisted of 10 20-ft. sections of 22-in.-

dia. steel pipe, each weighing 1300 pounds. Arranged in a U-shape pattern, the pipes were laced with a 1-in. wire-wrapped cable that was anchored to a pair

of 1200-pound blocks. Low-tech materials were selected because they are readily available around the world and can be assembled without heavy construction equipment.

For their mock attack, researchers loaded a $\frac{3}{4}$ -ton pickup truck with 400

pounds of sand to simulate an explosive package. The remote-control truck was then driven into the barrier at 36 mph.

The collision, shown above, stopped the truck—shearing its engine from its mounts, severing the transmission and crushing the driveshaft in the process. While the pipes moved about 18 ft. from their original location, they remained attached and anchored, and could be quickly rolled back into a protective position.

Before deploying a working system, researchers plan to test smaller-diameter pipes and heavier trucks.

June Highlights

Colorful Heartbeats—Fear of infection may add color to your next checkup.

■ **Big Brother In Your Pocket**—New driver's license has a chip only the police can read.

■ **GPS Bridge Watcher**—Unique monitoring system watches a bridge over troubled waters.

Editor: Jim Wilson
Reporters: Louis Brill, Stefano Coledan, Steve Ditea, Mike Fillion, Kathleen Gleaves, Scott Gourley.

Technology Watch

Safer, Warmer Stethoscopes

Fear of spreading infections has launched a colorful new medical product, the Ygeia.

Resembling poker chips, the thin latex membranes slip on the end of stethoscopes. This prevents bacteria and viruses that lurk on the skin from being transmitted among patients when doctors listen to their hearts and lungs. After each exam, a doctor drops the used Ygeia in disinfectant. A half-hour later, it's ready for reuse.



The current practice of wiping stethoscopes with disinfectant provides insufficient contact time to clean the instruments, says Ygeia's manufacturer, SDPI of Echirolles, France.

Ygeias make exams more pleasant for kids and less trying for their doctors, too. SDPI says covered stethoscopes don't feel as cold on bare skin, so kids are less likely to squirm and cry. When kids are quiet, it's easier for doctors to hear young hearts.

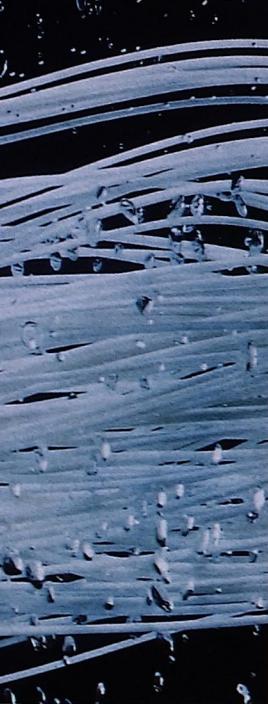


Bottle-Quality Water On Tap

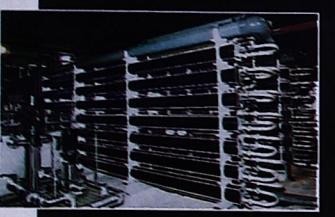
If you want a glass of really clean water, find a sink in Auvers-sur-Oise, France. The town's water is purified by one of the first commercial-scale nanofiltration systems.

Before being pumped into distribution mains, water circulates around bundles of narrow tubes. The liquid passes through their semipermeable surface, while bacteria and pollutants stay behind, says manufacturer Vivendi of Paris.

The company hopes to sell its nanofiltration units to American towns that want to abandon more expensive chemical-based disinfection.



FRENCH TECHNOLOGY PRESS OFFICE



Clean water flows to the center of tens of thousands of narrow tubes (above) that are placed inside racks (left).

Light Approach To Fill-Ups

Environmentalists around the world have their eyes on a new gas station at Germany's Munich Airport. It is the first public filling station where motorists can buy liquefied or gaseous hydrogen.

When hydrogen combines with oxygen from the atmosphere, it produces a considerable amount of heat, plus ordi-

nary water. And water is the ideal feedstock for making more of the fuel. For this reason, hydrogen is considered the world's most environmentally friendly fuel.

The filling station sells two grades: -423°F liquefied hydrogen for specially equipped BMW cars and gaseous hydrogen for airport buses.

Dusting Off A Stellar Mystery

When NASA's Stardust probe and Comet Wild-2 meet in 2004, a high-tech dustpan will collect clues that may help answer one of biology's most important questions. Could cometary material have brought life to Earth?

The space dust will be captured in aerogel, a porous, silicon-based material that resembles light blue smoke and feels lighter than a feather. As cometary dust hits the aerogel at 14,000 mph the impact will create carrot-shaped microtunnels. These will trap and protect particles for the trip home. Ground tests suggest that

while the particles will heat up they will still retain their structure and composition, says Martha Hanner, an astronomer at the Jet Propulsion Laboratory in Pasadena, Calif.

En route to Wild-2, the probe will make two attempts to collect interstellar dust. The first takes place in 2000, the second in 2002. Then, in 2004, the spacecraft will come within 100 miles of the icy nucleus of Comet Wild-2 for the main event.

Launched from Cape Canaveral in February, Stardust and its dusty cargo will arrive back on Earth on Jan. 15, 2006.

Listening For A Winning Beat

It takes more than strength to swim your way to Olympic gold. You also need an optimal stroke rate. "How to teach a stroke rate is one of the most challenging issues in coaching," says John Leonard, executive director of the American Swimming Coaches Association. A new underwater signaling device may help.

The Aquapacer from Challenge & Response of Scotland (419-526-1010) merges a timer with an underwater beeper. The coach programs the stroke rate into the pacer unit (far right). The swimmer hears this pattern as beeps emitted from a sounder (right), worn in his swim cap. The company says that several Olympic hopefuls are training with its device.

The Aquapacer can be programmed for 16 stroke patterns or 16 different swimmers.



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15 mg "tar," 1.0 mg nicotine av. per cigarette by FTC method.

SURGEON GENERAL'S WARNING: Smoking By Pregnant Women May Result in Fetal Injury, Premature Birth, And Low Birth Weight.



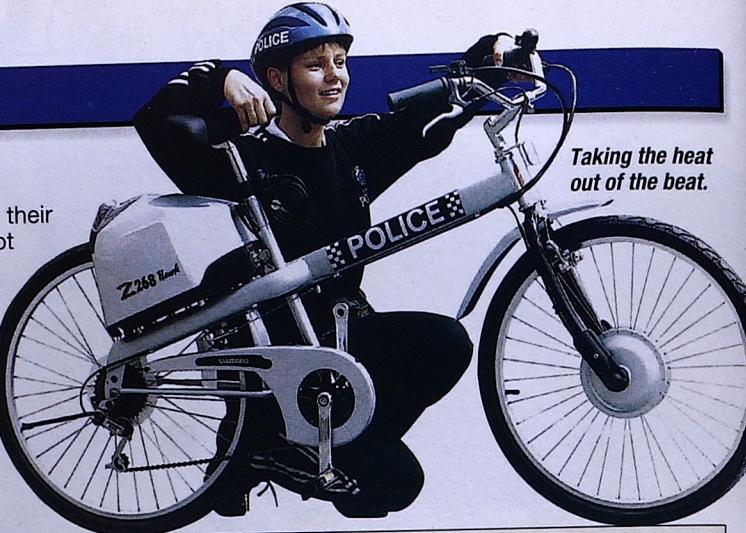
Keep it Basic

Technology Watch

Batteries Zap Bike Police

Bicycle patrols cut crime by getting police out of their cars and onto the streets. The tradeoff is that foot patrols can't respond as rapidly to more distant emergencies. Trading shoe leather for bicycles has increased response time, but it lags toward the end of an officer's shift.

One solution is a battery-powered motor. It doesn't turn a mountain bike into a motorcycle, but it can give police an added boost for climbing hills. Police in Durham, England, who have tested the bike say they can cover twice the distance on routine patrols and arrive at emergency sites in better shape to respond.



Taking the heat out of the beat.

PA NEWS CENTRE

Your History In Your Pocket

The state of New Jersey is planning an ambitious program to place information about a person's contact with law enforcement and government agencies on a computer chip built into his driver's license.

In addition to storing a digital image of the driver, it would summarize the person's history of run-ins with law enforcement, including arrests, convictions and traffic violations. It would also list scheduled court appearances.

The state official who designed the license told PM the software allows it to be linked to bank accounts. This would enable the holder to automatically pay for bus tickets or road tolls.



Hackers beware:
Attempting to read
your chip (above
left) could land
you in prison.

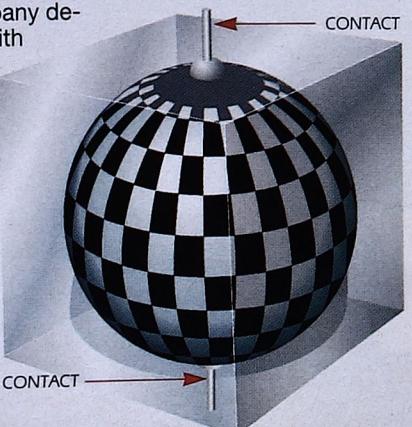
BILL ASKE

Spheres Make Cheap Chips

A new low-cost technology could replace flat microchips with spherical crystals.

Ball Semiconductor (www.ballsemi.com) says it has fabricated a transistor on a 1mm silicon sphere. To accurately etch circuit elements in 3D, the Allen, Texas, company developed a mirror with 45 facets to transfer a circuit pattern while compensating for spherical distortion on the silicon surface.

The chief source of sav-



The sphere could mean the end of flat silicon chips.

PAUL PERREAU

Stylish Pocket Shooter

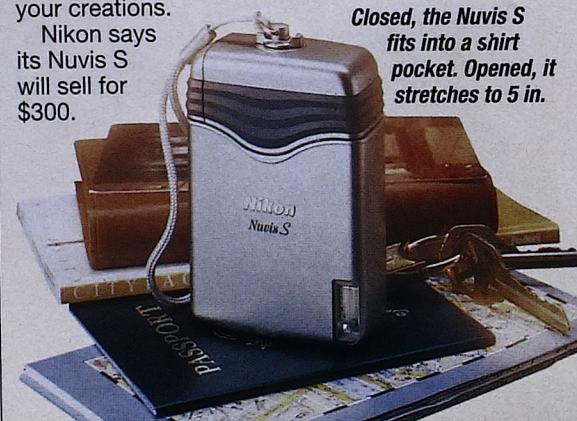
Nikon wants to put some stylish steel in your pocket. Its Nuvis S camera packages a sophisticated 35mm camera in a fast-opening stainless steel case.

The heart of the Nuvis S is a Nikon 22.5mm-to-66mm zoom lens with precise 432-step autofocus. A range-correction system incorporated into the lens allows 18-in. closeups.

Other features include red-eye reduction and an autofocus illuminator that engages in low-light situations for sharper focused nighttime pictures.

There are four flash controls. A "slow sync" setting augments available light with a flash. Using the optional infrared remote control you can step into your creations.

Nikon says its Nuvis S will sell for \$300.



Closed, the Nuvis S fits into a shirt pocket. Opened, it stretches to 5 in.



If the idea of installing insulation makes you think of these, you haven't heard of ComfortTherm.™

Installing insulation will never conjure up images of agony, misery or torture again, as long as you use ComfortTherm™ encapsulated insulation. ComfortTherm™ is wrapped in plastic, creating a barrier between you and the fiber glass. Which means there's less dust. And less dust means less itching. But ComfortTherm™ doesn't just make your remodeling project painless, it's also superior to



Ordinary Insulation produces dust that makes installation messy and uncomfortable.



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Technology Watch

Bridge Over Troubled Waters

Strong currents, high winds and the constant threat of earthquakes make Japan's Akashi Strait one of the less inviting locations for building a bridge, let alone the world's longest suspension bridge.

Those same conditions also make it imperative that engineers who are responsible for bridge safety have the most accurate information possible about the subtle strains imposed by traffic and nature.

To precisely determine how the Akashi Bridge behaves, the Japanese government has installed a sophisti-

The GPS receivers make 10 measurements per second.

cated, 12-channel GPS measurement system. Developed by Leica Geosystems of Torrance, Calif., (310-791-5300) it consists of two GPS units mounted atop the bridge's twin towers and a third placed midspan. Working together, they can alert engineers to bridge movements as little as 1mm in any direction.

Computer Combats Disaster

Computer scientists have combined two computer programs developed for nuclear weapons work to make buildings safer. One program simulated blast physics, the other structural response. The new program, which runs on a supercomputer, can determine what happens to buildings in extreme conditions, such as explosions or violent weather.

"We want to use computers to test how a roof would fly off a building in a hurricane, understand why levees break, model how floors collapse in a gas explosion," says Rudy Matalucci, a civil engineer who leads the Architectural Surety program at Sandia National Laboratories in Albuquerque, N.M. "We ought to be able to tell you whether you'd survive a blast 10 floors below you in a hotel." Designers may one day use similar programs to quickly test layouts, construction materials and disaster-mitigation technologies before actually constructing a building.

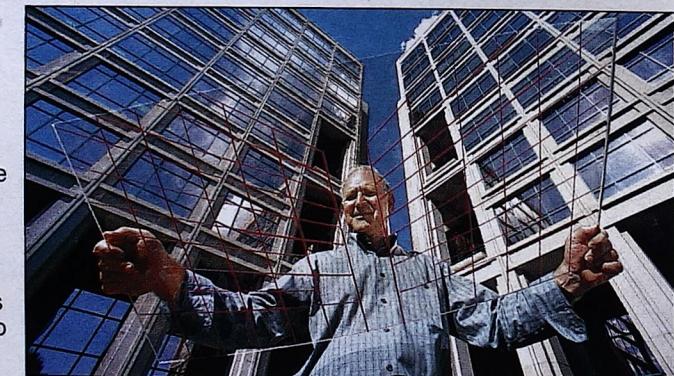
Future Fighter Refined

Boeing has refined the design of its Joint Strike Fighter (JSF) multipurpose aircraft.

The latest round of improvements include a reshaped empennage with horizontal tails for additional control power and a stealthier, aft-swept chin inlet. The company says the changes will make the jet less expensive to manufacture and maintain.

Boeing hopes to build a conventional takeoff and landing version of the JSF for the Air Force. Plans also call for a carrier-landing version for the U.S. Navy and a short takeoff/vertical landing model for the British Royal Navy and the U.S. Marine Corps. Performance characteristics will be tested from two X-planes that are currently under construction: the X-32A for the conventional takeoff and landing craft and the X-32B for the short takeoff/vertical landing variant.

"We've taken a very good design and made it better," says Dennis Muilenburg, director of JSF fighter systems.



New glass would prevent injuries by crumpling into sandlike fragments.

Searching For Oil With Air Guns

Until recently, Puget Sound has kept its seismic secrets well hidden beneath deep water and a thick layer of glacial silt. This may change as researchers from several area universities finish studying data from tests in which the seabed was blasted with giant sonic guns. To paint a seismic picture of the Puget Lowland region, scientists and students aboard the University of Washington research vessel *Thomas Thompson* fired a 6200-cu.-in. air gun into the water every 30 seconds. Information on sound-wave arrival times was used to create a 3D image of the subsurface region. Similar methods have helped locate oil in the North Sea.

Wheat Starch Strips Jet Paint



NORTHROP GRUMMAN

Technicians at Northrop Grumman's stealth bomber plant in Palmdale, Calif., have found a faster way to strip the paint off F/A-18 Hornet strike fighters. Instead of hand sanding, they spray the planes with a pressurized blast of wheat starch.

The new technique takes less than half as long as hand sanding, which typically consumes four weeks.

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Technology Watch

Salmon At Risk

• Nine species of salmon from the waters around heavily populated areas of Oregon and Washington have been placed on the federal endangered species list.

Fisheries experts say that the salmon are threatened with extinction because runaway development has altered their natural habitat.

Restoring the salmon is expected to require a decades-long effort that would include broad restrictions on logging and housing developments.

PCBs Turn Toxic

• A study of bottlenose dolphins that died after being stranded in Texas's Matagorda Bay has revealed toxic levels of PCBs in their tissues.

"People accumulate

these compounds in their body fat just like dolphins," says Texas A&M University toxicologist David Busbee.

The finding raises questions as to whether people living near the bay or eating seafood are accumulating high levels of PCBs.

Cut The Fertilizer

• American farmers can eliminate the 7000-square-mile "dead zone" in the northern Gulf of Mexico if they can keep more of the fertilizer they put on their land from washing into the Mississippi River, says Otto Doering. The Purdue University agricultural economist studied the link between farming and the Gulf.

The area is created because of excess nitrogen

PLANET WATCH

emptying into the Gulf each summer. It accelerates the growth of algae, eventually leading to oxygen depletion that forces fish to swim away.

Reducing excess nitrogen in runoff from farmlands by 20 percent could restore sufficient oxygen and bring marine life back to the region.

How's The Water?

• Europeans plan to take the Pacific Ocean's temperature, from space.

Final testing is being completed on the Advanced Along Track Scanning Radiometer (AATSR). Next year it is scheduled to be launched on Envisat, the European Space Agency's environmental monitoring satellite.

Traveling on a near-polar orbit, AATSR's primary objective will be to obtain precise measurements of global sea surface temperature. Of particular interest will be the large-scale shifts in Pacific Ocean temperatures associated with the periodic El Niño events.

During the 1997-98 El Niño, higher water temperatures may have led to droughts and forest fires in Indonesia and violent storms along the west coast of the Americas.

Antenna Clears, Cools

The antenna on your next car could do more than let you listen to the radio. It might also help you see better in winter and stay cooler in summer.

Eric K. Walton and his engineering students at Ohio State University are developing a multipurpose automobile antenna from off-the-shelf auto parts. One of their designs converts the metal film automakers now use as a sunscreen into an antenna. The other prototype captures radio signals with the wires now used in rear window defrosters. The next step is to merge the two designs. "If we put both together, we could produce a windshield that can help cool a car in summer, defrost it in winter and receive AM/FM signals," he says.

You won't see a thing if Walton's team succeeds—the antenna will be transparent.



An isolation transformer allows power and radio signals to coexist.

DON MANNES

Jack Puts A New Spin On Heavy Lifting

When you need to lift a heavy load, it's hard to beat a crane. Unless you are working in cramped quarters or on a job site covered with overhead wires.

Here, the typical solution is to use pneumatic or hydraulic jacks, which often open up a whole new range of fluid leakage and power supply problems.

Pete Matuszak of New Berlin, Wis., came up with a novel solution by putting a powerful new spin on an old idea, the screw jack.

A 12-hp engine turns what is essentially a heavy-duty version of the screw jacks used to level sagging floors. Matuszak's company, Airjack (pmatus@execpc.com), demonstrated the Lift by raising an 80-ton excavator and 100-ton rock crusher. For an encore they plan to lift a locomotive.



The Lift is operated by a wire or wireless remote control. Individual Lifts can "talk" to each other to keep equipment level while it is being raised.

26

(More Technology Watch on page 28)

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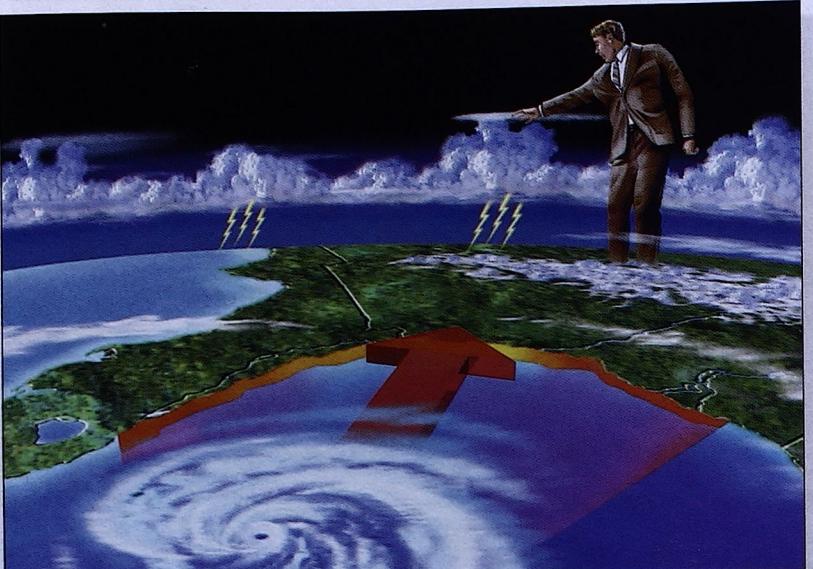
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Technology Watch



Weathermen Get Into Their Jobs

Television industry executives say that the principal reason viewers watch their local stations is to see the next day's weather forecast.

For owners of TV stations in markets that are served by several local stations this can be a big problem because there are only so many ways to present weather data. For this reason, weathermen are always looking for ways to make their maps and reports seem more exciting.

Walk Through Weather, new video presentation software from Weather Central of Madison, Wis., promises to sharpen a station's

competitive edge by putting local forecasters in the middle of their weather reports.

Instead of seeing the local weatherman standing in front of a regional map dotted with meteorological icons, the software projects a moving image of the forecaster in the middle of 3D representations of the fair or foul weather being forecast.

This human touch is added to an otherwise dry—or wet or windy—forecast by advanced computer graphic imaging systems running SGI's new software.

Walk Through Weather won't improve the accuracy of forecasts, but it will make them more entertaining, even if it is about to rain on your parade.

PAUL D'AMARE

Mock Balloons Light The Night

Balloon lights have been a popular way of brightening outdoor events. But it isn't always possible—or economical—to use helium to keep them aloft.

Airstar America of Los Angeles (800-217-9001) has created a nonhelium version of its popular lights. Called Crystals, these mock balloons sit atop thin poles that adjust from 8 ft. to 16 ft.

Illumination comes from a 500- to 2000-watt lamp protected by a wire cage and placed inside the fan-filled balloon.

Capable of lighting 22,000 sq. ft., Crystals can keep an outdoor party going from dusk to dawn.



Mock balloons give off soft, glare-free light and can be decorated or painted with logos.

AIRSTAR

Robots Sell Real Estate

Intelligent Kiosk of Edina, Minn., says it has spent \$11 million to develop a new type of robot. Looking more like a teller machine than R2-D2, it is aimed at replacing real estate salesmen, insurance agents and other people who work as information middlemen between customers and large corporations.



Intelligent kiosks can anticipate a customer's questions.

Submersible Radio

Situations that demand tactical radios don't always occur on sunny days. Racal Communications of Rockville, Md., says that its 24.5-ounce submersible Miniature Secure Handheld Radio (MSHR) is the smallest, lightest secure communicator in the world. Originally developed for special forces units, the 5-watt radio has settings for voice and data encryption.



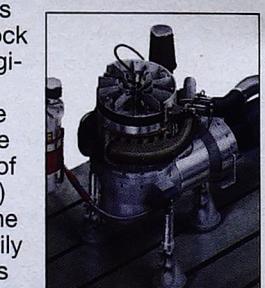
MSHR stays dry to depths of about 60 ft.

RACAL COMMUNICATIONS

Novel Engine For Hybrid Vehicles

A novel rotating block engine may have a future as a power supply for hybrid gasoline/electric vehicles.

Instead of spinning a crankshaft, the Crossover Rod Engine developed by Charles Candler of Powell, Tenn., causes the entire block to rotate. Engineers who evaluated the design for the Department of Energy (DOE) say the engine could be easily configured as a generator for use in hybrid vehicles.



DOE reviewed a 2.5-liter prototype engine.

CHARLES CANDLER

Tests Prove Restore Increases Engine Performance!

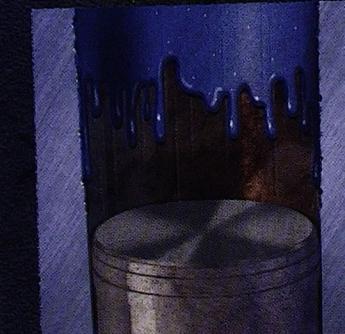
In normal driving, friction and wear cut scratches in the metal surfaces inside every car's engine. This causes compression and power loss and increases oil consumption as cars get older.



Wear Causes Scratches in Cylinder Walls



Add RESTORE to Engine Oil



RESTORE's CSL Formula Repairs Cylinder Walls



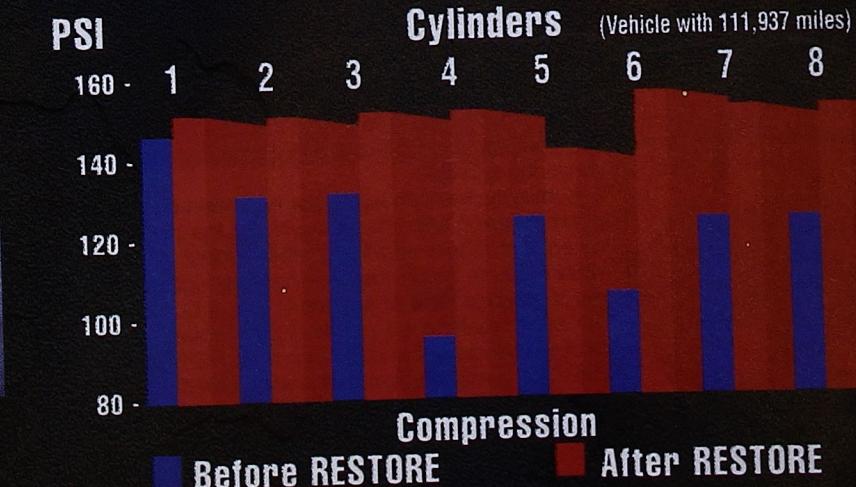
Compression and Power Restored to Near Original Levels

RESTORE with CSL fills these scratches and improves the seal between piston rings and cylinder walls.

This means better and more balanced compression across all cylinders which in turn restores engine power and reduces excess oil consumption in older engines. Independent tests prove that RESTORE with CSL really works to increase cylinder compression as shown by the graph below.

If you have a car or truck with a lot of miles, improve the engine performance with RESTORE. It's the only product that contains the exclusive CSL formula which fills and seals cylinder wear in addition to providing superior anti-wear lubrication. RESTORE really works! Satisfaction guaranteed.

RESTORE is available at all automotive retailers and major discount stores.



Technology Watch

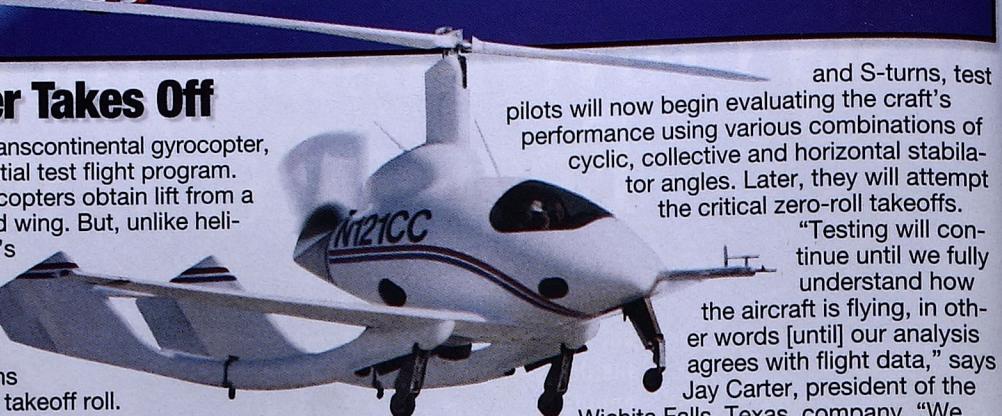
CarterCopter Takes Off

The CarterCopter, a transcontinental gyrocopter, has taken off on its initial test flight program. Like helicopters, gyrocopters obtain lift from a rotor instead of a fixed wing. But, unlike helicopters, a gyrocopter's rotor is freewheeling. Thrust comes from a conventionally mounted engine.

Normally, this means gyrocopters require a takeoff roll.

The CarterCopter differs in that its rotor is spun up prior to takeoff, providing just enough lift for a zero-roll takeoff (see "Coast to Coast on 125 Gal.", June 1996, page 48).

Having concluded a series of level flights



and S-turns, test pilots will now begin evaluating the craft's performance using various combinations of cyclic, collective and horizontal stabilator angles. Later, they will attempt the critical zero-roll takeoffs.

"Testing will continue until we fully understand how the aircraft is flying, in other words [until] our analysis agrees with flight data," says Jay Carter, president of the

Wichita Falls, Texas, company. "We expect some setbacks during testing. But we haven't uncovered anything that dampens our enthusiasm." Watch a video of the latest tests of the CarterCopter on the PMZone.

CARTERCOPTER

The CarterCopter's rotor is spun up before takeoff, to provide power for a nearly vertical liftoff.

Telegraphing A Solar Punch

Solar physicists believe it may now be possible to accurately predict intense magnetic bursts, known as coronal mass ejections, several days in advance.

They report a strong correlation between an S-shaped pattern on the sun, and the likelihood that an ejection will occur from that region within days. Magnetically disturbed regions that display a symmetrical, or butterfly-like, shape rarely erupt, say researchers.

"The S-shaped regions are the dangerous ones," says Richard Canfield of Montana State University.

The finding is good news for the electric utility industry. As powerful as billions of nuclear explosions, solar bursts have a reputation for destroying unprotected equipment.



Columbus Puts Fun Into Science



A bold new community development project aims to make Columbus, Ohio, the first city people think of when the topic turns to science or technology.

"We are building a great science center as the focal point for our downtown," says Dimon R. McFerson, chairman of the board of trustees of COSI, formerly the Center of Science and Industry. "That says everything about our sense of where the future lies."

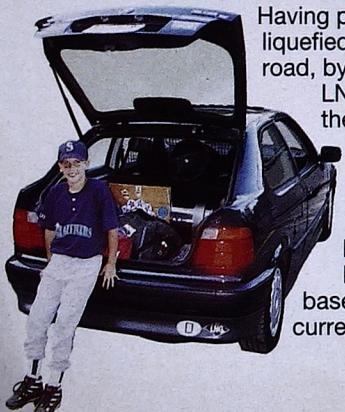
The centerpiece of this effort will be a new \$125 million, 320,000-sq.-ft. science education building, designed by world renowned architect Arata Isozaki.

The new structure will be divided into "learning worlds" that explore topics in depth. Ocean Learning World will feature a simulated shipwreck. Adventure World takes visitors to an archeological dig. Other worlds will explore computers, space and medicine. The center opens in November.

COSI will anchor a \$2 billion urban renewal zone on Ohio's Scioto River.

COSI CENTER: JAPAN

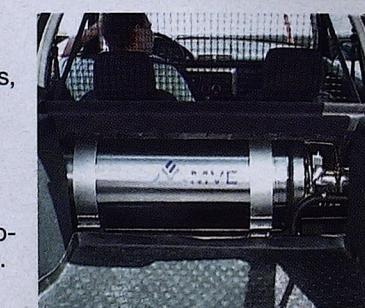
At -260°F It Is The World's Coolest Car



Having proved its safety in more than 2000 trucks and buses, liquefied natural gas (LNG) is ready to take its show on the road, by powering a BMW.

LNG is, mostly, methane gas that has been cooled to the point where it becomes a liquid. As the car drives, a heat exchanger vaporizes small amounts of the -260°F liquid. Since methane has the highest hydrogen-to-carbon ratio of any fossil fuel, it burns clean. The key to making it a practical automotive fuel is building cylinders that can keep the LNG cold.

MVE-INC, a manufacturer of cryogenic equipment based in Burnsville, Minn., designed the system that is currently being tested by the German automaker.



The production version of the insulated tank will weigh about as much as a regular gasoline or diesel fuel tank.

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THE BIRDS.

THE BEES.

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Technology

Planning A Remodel? Go Digital

BY KIM KOMANDO

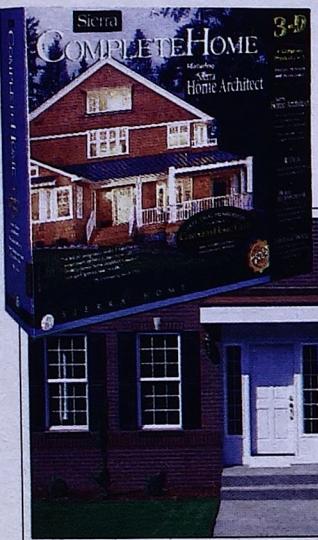
Let's say it's 20 years

ago and you want to remodel/redecorate/relandscape your home—or maybe build a new one. Where to begin? You've probably got

THE KOMANDO REPORT COMPUTERS

some sort of plan in mind, but committing it to paper is another matter. Like it or not, you'll be shelling out a pretty penny for an architect, decorator or other professional to create a workable plan. Now fast-forward to the present. You've got the same idea, but where to begin?

Instead of paying a high-priced professional to transform your ideas into plans, you spend a fraction of those costs on software for your personal computer. In just a



With or without posies? Sierra's CompleteHome lets you contemplate this dilemma.

few hours, professional custom plans are spitting out of your ink-jet printer. What's more, you can see the completed project in 3D on your computer monitor.

Welcome to the world of home improvement software. After exploring several software packages that fall into this category, all we can say is: While none of the programs will totally replace residential architects, designers and decorators—they had better watch out!

Following are reviews of home improvement suites—which are complete software packages including several applications designed to meet a wide variety of home improvement needs.

CompleteHome

Sierra Home
www.sierra.com
about \$50
Windows 95/98

While CompleteHome is more a collection of individual applications than an integrated

suite, it's really quite powerful. The cornerstone of the package is Home Architect. Other applications include: Photo HomeDesigner (similar in concept to Imagine Your Complete Home & Landscape, but not as robust), 3D Deck, Home Improvement Encyclopedia, and Electrical Wiring. As an added bonus, you get a printed book called *Home Repair Essentials* that's handy even when you're not using the software. This program is also loaded with interactive help. If you don't want to start from scratch, you have two options. First, you can load one of the hundreds of designs that are included with the program. Your other option is the Quick Design wizard. This allows you to simply describe the house you want to build. Once you're done, the program assembles the house you've described into a floor plan. Then you have the chance to see how your original idea fared in the digital zone.

I especially liked Home Architect's interface. The program splits the screen in two. On the left, you see the floor plan. The right side displays

a three-dimensional rendering of the house. What's more, by using a little controller under the rendering, you can take a real-time walk-through of the house (complete with the sound of your footsteps) any time you want.

Imagine Your Complete Home & Landscape

MacMillan Digital
www.macmillansoftware.com
about \$50
Windows 95/98

When we look at any software suite, there are a few things that we look for, no matter what category the software happens to fall into. Among them:

- Integration. Do the programs really work together, or do they just happen to be thrown into the same box?
- Ease of use. When the program loads for the first time, is it somewhat obvious what you're supposed to do?
- Help. For the parts that aren't obvious,

Nothing lasts longer.



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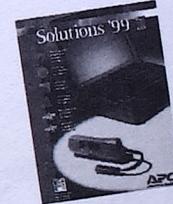


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Technology



You can get as creative as you like with this FloorPlan 3D software.

is it easy to get to the information you need?

On all three counts, Imagine Your Complete Home & Landscape delivers. This package includes five modules: Deck, Pool and Hot Tub; Interior Design; Dream Home; Landscape; and Remodeling. You start with a photograph of your house. Then, using basic drag-and-drop techniques, you exchange elements in the picture with photographs of other elements on one of the five CDs. For example, suppose you're considering replacing a window on the front of your house. You bring in a digital image of your house (using a scanner or digital camera). Next, you outline the window you want to replace. Then you drag the window you want from a floating palette to the outlined area. Bingo! You've got a new window. The program automatically scales the new window to fit the area you outlined. The advantage is that you see your changes in photographic quality.

This software has a great help program. For starters, there's a collection of fully narrated video tutorials that show you step by step how to perform various tasks. There's also built-in voice and video help. As you become more familiar with the program, you can turn these handholders off.

We've got one complaint. Imagine Your Complete Home & Landscape works with photographs, so it's great for visualizing this change or that. However, if you want to print out plans or produce a list of materials, this is not the best program for you. If you would be satisfied printing out a picture, handing it to a contractor, and saying, "Here, make it look like this," this is a very easy and powerful program.

FloorPlan 3D Design Suite

IMSI
www.imsisoft.com
about \$55
Windows 95/98

This package comes with four separate appli-

cations: FloorPlan 3D, 3D Garden Designer, HomeStyles Home Design Encyclopedia and TurboProject Express. While FloorPlan 3D doesn't offer all the touchy-feely help of the other programs reviewed thus far, it does offer some powerful tools to help you address the task at hand. The program's biggest claim to fame is the availability of photorealistic 3D renderings that allow you to see what your dream house will really look like. Believe me, this is a mixed blessing.

On my Pentium II 350-MHz machine, I let the program churn away for nearly 30 minutes so I could see a photorealistic image of a kitchen with a refrigerator in it. In frustration, I finally clicked the stop button to see what the program had come up with so far. While the photorealistic effect was interesting, I didn't find it especially useful.

One of the biggest drawbacks to FloorPlan 3D is that it doesn't come with any sample floor plans. If you're not ready to start from scratch, this isn't the program for you.

3D Home DesignSuite

Broderbund
www.broderbund.com
About \$55
Windows 95/98

The less said about this package the better. It's a classic example of a few CDs being thrown into a box and labeled a suite. Even the inside packaging makes it clear that these four programs—3D Home Architect, 3D Home Interiors, Imagine Your Landscape and HomeTime Projects—weren't necessarily meant to be together. 3D Home Architect is the least intuitive of the floor plan designers reviewed here. You launch the program and are essentially left staring at a blank screen and a toolbar. Some might argue that this is what the manual is for. However, we've always believed that a good program for the home user should invite you to get your feet wet at least a little before you crack the manual. To add insult to injury, the programs bundled into this suite aren't even current versions. While the suite includes 3D

Home Architect 2.0 and 3D Interiors 1.2, Broderbund is shipping 3D Home Architect 3.0 and 3D Interiors 2.0 as separate products—for \$50 each. We took 3D Home Architect 3.0 for a short spin and didn't find it any

more intuitive than its predecessor. Honestly, you'd be better off investing your \$50 on one of the other programs reviewed here.

You can find Kim Komando's site on the Internet at www.komando.com.

(Please turn to page 36)



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Technology

The Way To San Jose

BY TOBEY GRUMET



The purple and orange Tech Museum looms over downtown San Jose.

Remember walking

through your local natural history museum? Remember the feelings of wonder and excitement as you looked at reconstructed dinosaur bones, DNA molecules or the inside of a giant redwood tree? You could have spent hours just looking, touching and interacting with all kinds of history, technology and science, right? Recently, I visited a museum that recaptured those feelings of wonder—with a new technological twist.

The new Tech Museum of Innovation in downtown San Jose, Calif., is really the first museum specifically built to display new

technologies and real-time interactivity rather than science.

MEDIA And what better place to plop this orange and violet concrete structure than Silicon Valley, the true home of high tech?

The museum is made up of three levels, two of which are browsable. There's also a Sony IMAX theater, which is always a treat, especially after spending a few hours walking around the four exhibit areas. First thing to remember if you're going to check this place out: There are tons of kids. The museum was built for children grades six and up, so you might want to consider arriving later in the afternoon, around 2 or 3 pm, after the throngs of students have gone back to their schools.

Everything in The Tech was made to stimulate your senses, and every exhibit is explained in easy-to-understand language. The Center of the Edge, on the bottom level, includes an exhibit on Mass Hallucinations, allowing you to see yourself in real time as a computer enhances your image with special effects.

two others and play with varied electronic components to your heart's delight. There's even one stand where kids are handed a screwdriver and a pair of goggles and told to take apart a computer.

Upstairs, you'll find a complete Robotics section, including a virtual design studio. There's also a virtual bobsled ride, as well as a camera to take a picture of your face. The image is then inserted into four different scenes, which include a pair of cloned sheep and a hockey player's mask, that you'll find on monitors mounted on the ceiling.

If you're in the mood for a bit of sadism, go check out the genetically altered mice. I was attracted to this area by the cute, chubby mice I saw in the first glass cage. But as I looked closer, these were really obese mice, used for a study on human obesity, injected with a hormone that allowed them to eat and eat and eat without realizing they were full.

In the cage below them, you'll find a pile of smaller brown mice huddled in the corner of their cage. These mice are "heart disease mice" injected with a human gene to make them 20 times more likely to develop hardened arteries and other health problems. This, strangely enough, was the only part of the museum where I encountered no lines or children.

The ground level of The Tech is where you get your tickets, grab an overpriced burger and play with some oversize technologically advanced exhibits.

The Tech Museum of Innovation is located at 201 S. Market St., San Jose, CA. You can obtain hours and other information by calling 408-294-TECH. Or you can visit the museum's Web site at www.thetech.org.

FM

It's like looking at your face in a fun house mirror.

In the Communications area, you can send and receive fiberoptic messages in an exhibit bedecked with wires and lights. Or send a live video signal to a satellite using a professional video camera. And for the openly paranoid, there's an area explaining who can read your e-mail. Answer: your boss, system operators, the police, among others.

I loved the areas marked "workshops," where you can sit down with one or

two others and play with varied electronic components to your heart's delight. There's even one stand where kids are handed a screwdriver and a pair of goggles and told to take apart a computer.

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Science

Throwing A Wrench At Cancer

BY JIM WILSON



By preventing the production of critical proteins, antisense drugs throw a wrench in the molecular machinery of diseases.

A brand-new class of

drugs soon to appear on pharmacy shelves could change the practice of medicine as profoundly as the introduction of antibiotics. Known as "antisense drugs," they will work unlike any medicine ever created. Instead of attacking the bacteria or viruses that cause diseases they will literally throw a wrench into the portion of a cell's genetic machinery that produces disease-related proteins.

The first antisense drug, Vitravene, recently won FDA approval for use as a treatment for a viral infection that can rapidly blind ad-

BIOTECHNOLOGY

vanced AIDS patients. Its developer, Isis Pharmaceuticals of Carlsbad, Calif., (www.isisp.com) has six other antisense drugs in various stages of testing.

Industry analysts believe that over the next several years the dozen or so other companies that specialize in this new technology will seek FDA permission to market antisense drugs that can treat infectious, inflammatory and cardiovascular diseases. The most striking application for antisense drugs, however, promises to be in fighting the approximately

200 diseases we collectively refer to as cancer.

The versatility of antisense drugs derives from the fact that, after water, our bodies are made mostly of proteins. Remove the moisture and protein from a typical adult and what's left won't quite fill a cigar box. Proteins occupy a similarly large place in medicine because, in addition to building bodies, they also regulate body functions. Proteins carry and translate the instructions for building new cells. A class of proteins known as enzymes speeds up chemical reactions. Proteins form the pipes and pumps that move raw materials into cells and carry out finished products—mostly other proteins. When we cut ourselves, or inhale or ingest an infectious organism, proteins in the form of antibodies rush

to the rescue. They attach themselves to the invaders, then round them up for scavenger cells to destroy. You're not aware of this ongoing drama unless you get sick—usually very, very sick. If, for example, your body produces too little of the protein insulin you will be diagnosed with diabetes mellitus.

The Protein Train

Antisense technology is appealing to pharmaceutical companies because it has the potential to treat both a large number and a wide range of diseases. In theory, the therapeutic potential of antisense drugs is limited only by the human body itself. "We could make antisense drugs for every gene," predicts Isis founder and CEO Stanley T. Crooke.

To understand how this might be possible, imagine a protein as being a freight train. Trains are assembled from specific types of rolling stock—boxcars, coal hoppers, tanker cars and so on. To be useful for a particular job, a train has to be made from the right type of rolling stock. A train consisting of coal hoppers isn't very useful to the operator of an oil refinery. The rolling stock for the human body's protein train consists of 20 different amino acids. And an improperly assembled

protein can't do its job either.

Antisense drugs work by preventing improperly assembled protein trains from ever leaving the cellular station. To produce a protein, the cell first makes a messenger RNA (mRNA) copy of the gene containing the necessary information. "This message is then read by the cell and translated into the process to produce the protein," explains Crooke.

Protein production is a complex, two-step process. The first step, called transcription, occurs in the nucleus. This is the part of the cell that holds the DNA, or genetic recipe for life. The recipe for a particular protein is copied from a section of DNA—a gene—into mRNA. The mRNA then leaves the nucleus. The second step, called translation, occurs in the surrounding area, outside the nucleus but inside the membrane that forms the cell wall. Amino acids floating in this viscous sea of cytoplasm couple to each other, in the precise order specified by the mRNA. The finished product: a new protein that can become part of a muscle, eyeball or toenail.

Antisense technology uses synthetic DNA or RNA—called oligonu-

cleotides—to block the production of faulty proteins. "An antisense drug specifically binds to the mRNA coding for a target protein to prevent the cell from using that mRNA to make the target [disease-associated] protein," says Crooke. These custom-designed compounds are called antisense drugs because their molecular structure is the opposite of the "sense" or pattern of the original mRNA.

A Sense Of Antisense

Returning to our protein-train analogy, antisense drugs can be envisioned as obsessive rail yard supervisors who do not simply cross out instructions for the wrong types of rolling stock, but carefully write over the letters of the misprint, in ink that exactly matches the color of the paper. Instructions that can't be read can't be executed—to make freight trains or proteins.

In medicine, simple theories usually prove difficult to execute. It took 20 years for the theory behind antisense technology to mature into the first commercial product. Initially, scientists believed that antisense drugs would target cells with

such precision that they could cause few side effects. But as tests with animals began, the first antisense agents proved too toxic to be practical. Many of the first firms in the business suffered the same fate as their laboratory animals.

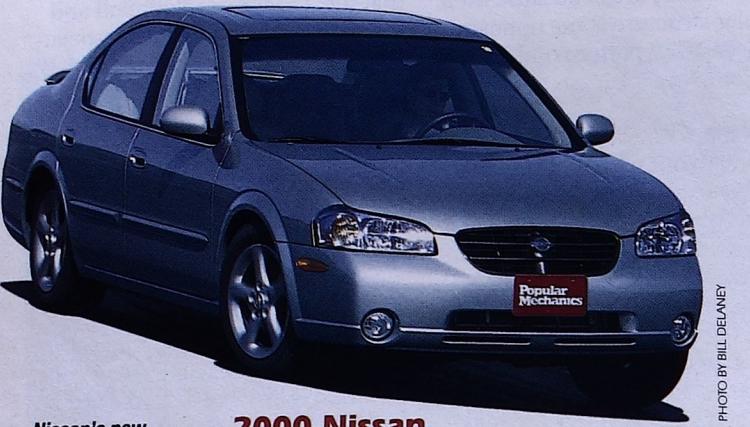
Industry analysts now believe that most of the development and manufacturing difficulties associated with producing large quantities of the synthetic nucleic acids needed to make antisense drugs have been licked. There is, however, the question of whether all disease-causing genes will be as easily deactivated as those that cause the diseases for which the first antisense drugs were developed.

Although antisense drugs may someday defeat a broad range of diseases, their most important contribution is likely to be in the war on cancer. Current cancer treatments rely on surgery, chemotherapy and radiation to beat masses of renegade cells into submission. By throwing a carefully aimed wrench at malfunctioning genetic machinery, antisense drugs could, in a manner of speaking, stop the cancer before it begins.

PM

Automotive

Reports From Around The World



Nissan's new Maxima is quieter and smoother than before, thanks in part to a much stiffer structure.

2000 Nissan Maxima

The Maxima's place in life is a lonely one. It lives somewhere between the ordinary Camrys and Accords, and the less ordinary Audis and BMWs. It's a sedan that delivers the reliability of the former with the performance and personality of the latter—all at a price somewhere in between. The 2000 Maxima continues down this same solitary road, only now it does it with more interior room, a larger trunk, a longer wheelbase and 222 hp.

Still available in GXE, sporty SE and luxurious GLE trim, all Maximas are powered by the same 3.0-liter DOHC 24-valve V6, which is bolted to either a very silky four-speed automatic (standard on GLE) or a five-speed

NEW CARS

manual. The increase in power over last year's 190-hp engine is courtesy of improved breathing, including the Nissan Variable Induction System that switches between long and short intake runners according to engine speed, and a new variable capacity muffler that reduces back pressure when the engine is revved over 2000 rpm. At any rpm, the V6 is strong and smooth.

—Scott Oldham

2000 Chevrolet Impala

We all remember fondly the original '60s and '70s Impalas. Enter the '00s and the latest corporate vision of a sporty sedan called Impala. Few will confuse the new front-drive V6-powered antelope-boasting sedan with its ancestors.

Taken on its own, it's a value-packed midsize



2000 CHEVROLET IMPALA

conveyance. The list of features goes on: ABS, traction control, tire-inflation warning, 16-in. wheels, aluminum alloy front subframe and steering knuckles, dual-control a/c, steering-wheel-mounted a/c and much, much more. More important, the driving experience is excellent. Powerful, grabby brakes that don't feel like you're stepping on a stuffed animal, steering with good on-center feel and precise tracking make this a driver's car. The interior is roomy, comfortable and bursting with standard features that other cars in this class charge you for.

—Mike Allen

2000 Toyota Tundra

Unlike its predecessor, the undersized, underpowered T-100, Tundra appears to match the performance and towing strength of America's trio of traditional full-size pickups. This time, Toyota seems to have it right, with Tundra offering impressive mechanical competence



and a cabin with amenities that lean more toward the comfort of a sedan than that of a capable work truck. Base engine is a 3.4-liter 190-hp V6, optional is a 4.7-liter 245-hp V8. Body styles include standard cab with 8-ft. bed and four-door Access Cab with 6½-ft. bed. Two- or four-wheel drive is available. Overall, the cabin will impress you as slightly less roomy than its U.S. counterparts, but more carlike in its details. Ride motion is more akin to a sedan than a truck, too.

—Jim Dunne

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Automotive

the Xterra offers the on-road comfort and price point of car-based SUVs, like the Toyota RAV4 and Honda CR-V. But it's larger and has a full frame, an optional V6 and plenty of off-road capability like the Toyota 4Runner, Isuzu Rodeo and Mitsubishi Montero Sport.

On the road the Xterra's ride goes beyond what has been previously accomplished with rear leaf springs, and its plasticky but useful interior is perfect for this type of vehicle. Plus, it seats four very comfortably and, with the rear seats folded, easily swallows two mountain bikes.



2000 NISSAN XTERRA

Available in two- and four-wheel drive, the Xterra comes standard with a 2.4-liter 143-hp four-cylinder and a five-speed manual. But splurge on the torquey 170-hp 3.3-liter V6, which works with either the manual or the available four-speed automatic transmission.

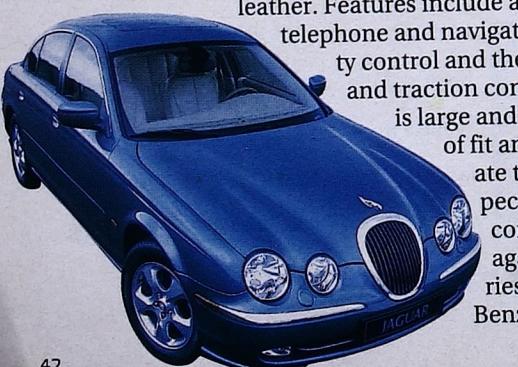
There are two trim levels, and each comes with standard ABS, skidplates and a 50/50-split fold-down rear seat. We also recommend the Utility Package, which adds such useful stuff as the tubular roof rack with gear basket, tubular step rails, bigger tires, six ceiling tie hooks and a first-aid kit.

—S.O.

2000 Jaguar S-TYPE

This is Jaguar's comeback kid, the reasonably priced sedan based on (*gasp!*) a platform shared with parent company Ford. Rest assured, no one will confuse this with a Taurus. It's a rear-wheel-drive luxury car. Propelled by a Jaguar-assembled 4.0-liter V8 version of the engine destined for the Thunderbird, the S-TYPE's suspension is truly supple over the worst of L.A.'s freeways, and still firm enough to provide astonishing roadholding on mountain switchbacks. Jaguar's sporting image loses nothing here, nor does its luxury image. The available V6 engine is derived distantly from the Vulcan V6 in the Taurus, but seems much more powerful and smooth. The interior appointments are covered almost totally in wood and leather. Features include a voice-activated telephone and navigation system, stability control and the customary ABS and traction control. The rear seat is large and plush, and the level of fit and finish appropriate to Jag's image. Expect the S-TYPE to be competitively priced against the BMW 5 Series and the Mercedes-Benz E-Class.

—M.A.



42



1999 Kawasaki Drifter

The newest Kawasaki Vulcan 1500 is the Drifter, an interesting mix of yesterday and tomorrow. With its fully valanced front and rear fenders and spoked wheels, harking back to bikes of the 1940s, it has all the modern conveniences: a single-overhead-cam 1500cc V-twin engine with four valves per cylinder, electronic fuel injection, digital direct ignition and dual disc brakes. The engine mates to a five-speed transmission and shaft drive.

We rode the Drifter in both Miami and Daytona, and it drew crowds and rave reviews wherever we went. The engine starts easily, has plenty of torque, and revs to nearly 6000 rpm. The transmission shifts cleanly every time, and has its own neutral finder. Prices for the Drifter start at \$11,499. —Jim McCraw

2000 Mitsubishi Eclipse

The Mitsubishi Eclipse, longtime poster car for the hot-rod import movement, is growing up. No more turbochargers, all-wheel drive or sloping hatchback silhouette. When the 2000 Eclipse goes on sale this July it will have an all-new look, it'll measure a little over 3 in. longer and, for the first time, it'll be available with a V6 engine. There will be

three models to choose from, RS, GS and GT, ranging in price from about \$16,000 to a fully loaded \$25,000. RS cars aren't



PHOTO BY BILL DELANEY

strippers, however. They'll come standard with 15-in. wheels, power windows, power locks, air conditioning and a 2.4-liter four-cylinder making 155 hp.

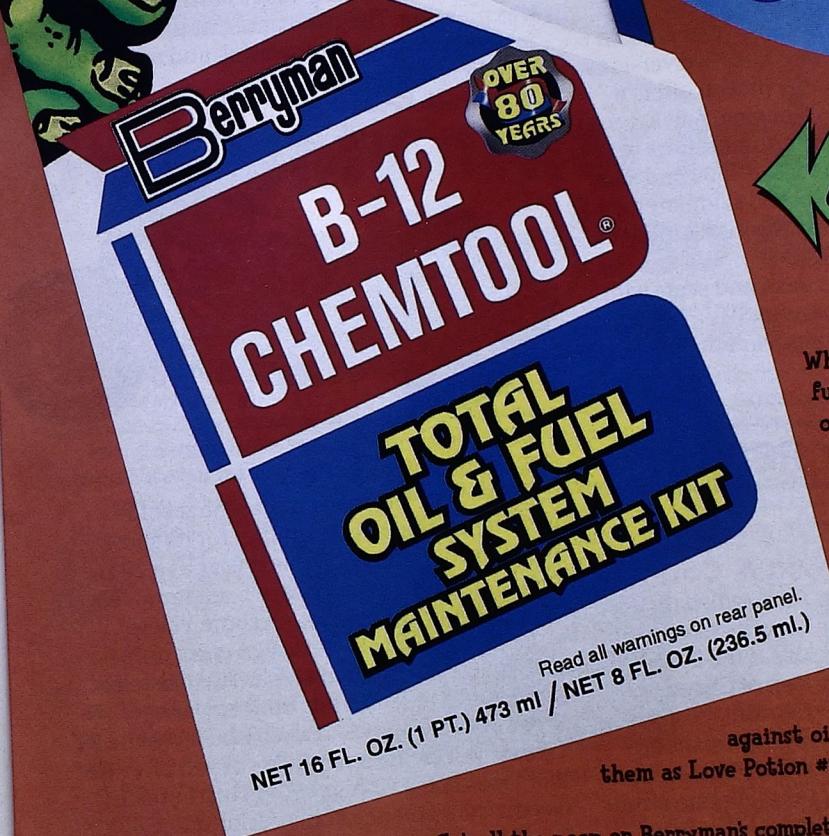
The GS gets 16-in. tires. But the GT is where the action is: It comes with a 205-hp 3.0-liter V6 and either a five-speed manual or four-speed automatic that can be shifted manually. GT also gets a strut tower brace, 17-in. wheels, rocker panel bodywork, an optional rear spoiler and optional leather.

While still a hatchback, the car's coupelike roofline has increased rear headroom, while the 2-in.-longer wheelbase increases the legroom. In front, there's a twin-pod dash with better ergonomics. And side air bags will be available.

—S.O.

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Automotive

2000 Nissan Frontier Crew Cab

The Nissan Frontier Crew Cab will go down in history as the first compact pickup sold in America with four full-size



PHOTO BY BILL DELANEY
forward-hinged doors. By the end of '99, the larger Dodge Dakota will get four full-size doors, and next year Ford and Chevy will be fighting the door wars (see "Reinventing the Truck," April 1999, page 66).

But the Frontier Crew Cab is the first, and it's pretty cool. Sold in 2wd and 4wd versions in both XE and SE trim, the pickup offers a 170-hp 3.3-liter SOHC V6 engine. A five-speed manual and a four-speed automatic are available, with towing capacities of 3500 and 5000 pounds, respectively. ABS and skidslips are standard, as is shift on the fly on 4x4 models. And the bed is 4½ ft. long.

The interior shares its dash and seats with other Frontiers and the Xterra SUV. The back seat, while useful for adults, isn't the place to be on long drives.

—S.O.

DETROIT SPY REPORT

BY JIM DUNNE

2001 Chrysler Town & Country



All bundled up for security reasons, this is the 2001 version of Chrysler's minivan. While styling details are mostly hidden by the elaborate armor cladding, a few changes in the new vehicle are evident. Start at the rear

where the backlite is canted forward, taillights are wider and the rear bumper flows smoothly into the rear quarter panel at the top and ends. Two noticeable changes are seen in the sides where door handles are set lower and the mirrors offer a more aerodynamic shape. In front, headlights are taller, while the lower air intake is more rectangular. Those panels on the roof seem to hide a taller profile for more interior space.



2001 PT Cruiser

Chrysler's PT Cruiser is undergoing cold-weather testing in preparation for its showroom introduction early next year as a 2001 model. Disguise panels have been removed from this prototype, though some Velcro strips remain. Of all the design cues, only the wheels shown here and lack of Chrysler nameplates are different from anything shown at auto shows. Chrysler believes the PT Cruiser will create a new class of vehicle, one that looks like a vintage sedan, but in reality has the convenience and interior space of a modern minivan. As Chrysler officials note, the PT Cruiser is one practical vehicle that "kids in the family won't mind being seen in."

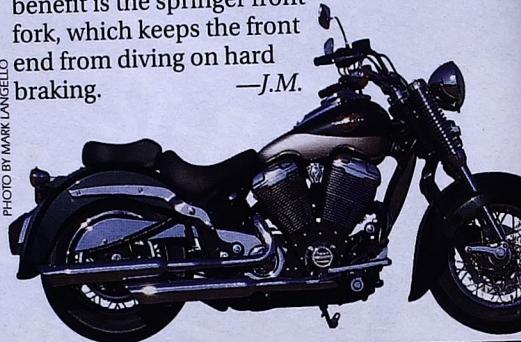
(Please turn to page 46)

1999 Excelsior-Henderson Super X

Another mixture of the old and the new is the Excelsior-Henderson Super X, a cruiser motorcycle that carries two famous names from the past. Built in a brand-new plant in Belle Plaine, Minn., the Super X cruiser uses a springer leading-link front suspension system with forks that go right through the front fenders, just like on the 1931 model, and a hidden single-shock rear suspension, to provide some retro appeal to the bike. The Super X is powered by a fuel-injected, DOHC eight-valve 1400cc 50° V-twin, decidedly not retro. It has a five-speed transmission and belt drive.

The huge front fork springs, valanced fenders, tall cylinders and big mufflers make the Super X look more massive than it feels. We found the engine responsive and powerful, with terrific midrange punch. The transmission shifted solidly, and the exhaust note, a bit loud with the optional slash-cut pipes, was pleasing. The front and rear disc brakes seemed particularly powerful, and an added benefit is the springer front fork, which keeps the front end from diving on hard braking.

—J.M.



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Automotive

ASIA SPY REPORT

BY SCOTT OLDHAM

2001 Toyota 4Runner



PHOTO BY HIDDEN IMAGE
This new larger 4Runner will go on sale in the fall of 2000. It'll share its ladder frame, four-wheel-drive system, engines and much of its interior with Toyota's new Tundra pickup truck. And it'll be built next to the pickup at the company's all-new factory in Indiana. But the big news will be the 4Runner's optional V8 engine. The 245-hp 4.7-liter DOHC V8 makes an impressive 315 ft.-lb. of torque, more power than the larger, more expensive Land Cruiser. To counter that, expect Land Cruiser to get variable valve timing and a considerable horsepower increase. Standard 4Runner power will be the Tundra's 190-hp 3.4-liter V6.

2001 Toyota MR Spyder



1.8-liter aluminum four-cylinder with variable valve timing, backed by either a five-speed manual or a four-speed automatic. Not quite the muscle to run with the twice-as-expensive Boxster, but it will run with and compete head to head with Mazda's Miata. In fact, the Spyder's dimensions are within an inch or two of the Mazda's, except for its 96.5-in. wheelbase, which is more than 7 in. longer than the Miata's. A four-wheel independent suspension, 16-in. wheels and four-wheel disc brakes are also part of the package.

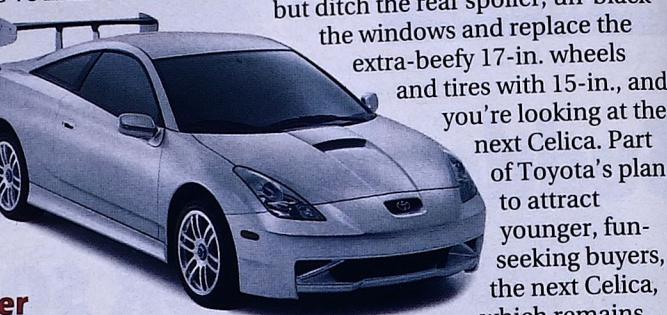
2001 Toyota Avalon

With all that attention toward the youth market, Toyota isn't forgetting who made it such a wealthy automaker, the baby boomers. For them, Toyota is working hard on the next-generation Avalon. Not as stodgy as the pre-



sent Avalon, the car's replacement will feature crisper, harder lines, sportier suspension tuning and more horsepower. The full-size, front-wheel-drive sedan will grow a bit, nudging its overall length past 200 in., and its 3.0-liter DOHC V6 engine will handle the extra heft with variable valve timing and a bump in horsepower from 200 to 220. Six-passenger seating will still be available, and the Avalon will continue to be built at Toyota's Georgetown, Ky., plant along with the Camry.

2001 Toyota Celica



For now, Toyota is calling it the XYR Concept, but ditch the rear spoiler, un-black the windows and replace the extra-beefy 17-in. wheels and tires with 15-in., and you're looking at the next Celica. Part of Toyota's plan to attract younger, fun-seeking buyers, the next Celica, which remains

a front-wheel drive, will be powered by an all-aluminum DOHC 1.8-liter four-cylinder that cranks out a stout 180 hp at a rev-happy 7600 rpm. This is made possible by variable valve timing and a very Honda-like redline of over 8000 rpm. A more mellow 140-hp version will be standard. Four-wheel independent suspension, four-wheel disc brakes and a 2500-pound curb weight should put this car in the performance category of the VTEC Acura Integra GS-R.

2001 Toyota Solara Convertible



The drop-top version of Toyota's successful Camry Solara coupe will also go on sale in the spring of 2000.

Mechanically identical to the coupe version of the car, the Solara convertible will get a power folding top, with a full headliner, a glass rear window, automatic-down power rear-quarter windows and structural reinforcement. The conversion from coupe to ragtop will be performed by ASC in a new facility near the Toyota plant in Cambridge, Ontario. Both a four-cylinder and V6 will be available in the open four-seater. **FM**



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Outdoors

The Flying Boat

BY CLIFF GROMER



A step up from the PWC, the Seair may be the next niche in watersports.

AVIATION □ The first time I tried hang gliding I crashed on takeoff. I had signed up for hang gliding 101 and my instructor told me to heft the wing over my head and run as fast as I could across a field. Seemed simple enough, and back in those days I was able to

gallop along at a pretty good clip. Trouble was, I had a trick left shoulder, and it decided to pop out just as my stride hit high gear. A nasty ground loop resulted, followed by a not-too-cheerful refund of the course fee and a red "F" on my permanent record card.

Too bad. Hang gliding is the closest I could have come to the essence of pure flight—being one with the wind and an integral part of the flying machine itself.

One step removed from the free-flight hang glider is the powered hang glider, a low-rung member in the growing family of ultralights. Bolt together a frame and attach wheels, engine, fuel tank, seat and wing and you're ready to soar with the pigeons. Powered hang gliders come in all kinds of configurations with the possible exception of a flying bath-

tub. One new design, however, comes close—the Seair 2000 flying inflatable boat. A harebrained change of pace for thrill-seeking members of the motorized bar stool crowd? Hardly. Taken in the context and accepting the limitations of an ultralight, a flying inflatable boat offers some interesting and viable possibilities.

Like most inflatables, the Seair can be used as a conventional tender for your yacht or cruiser. Then, whenever the urge strikes, bolt on the wing to convert the action from tow to go. Seair takes you where no other watercraft has gone before—up to altitudes of 10,000 ft.

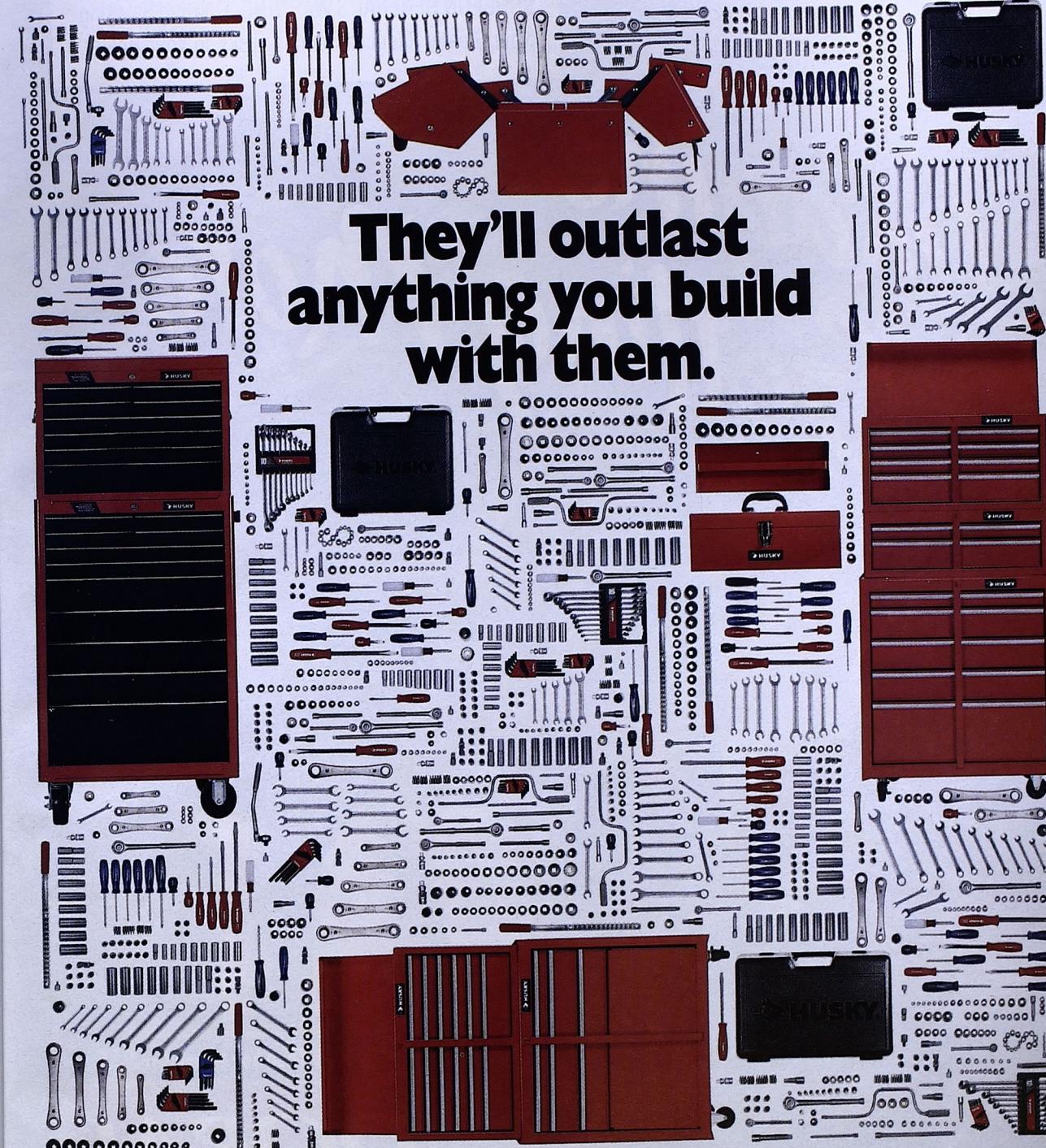
If you're into remote lakes and ponds for fishing and the joy of quiet, peaceful solitude, you might be able to claw your way through the wilderness to one in your 4-by. But your land tank can't survey five lakes in 30 minutes like you can do from the air.

Millions of viewers already have witnessed the Seair in a dramatic rescue action sequence filmed for the "Baywatch" TV series. According to Seair pilot Stan Pace, it wasn't easy. Sea conditions at the time were 7-ft. swells with a 2-ft. chop and an 18-knot crosswind. The boat had never before been subjected to such rough conditions in its 500 hours of testing. "At one point I had my hand on the seatbelt release button and was ready to ditch because I thought we were going over," recalls Pace. But the boat didn't go over. A conventional float plane never would have been able to handle that kind of water and wind situation.

Getting a firsthand look (and ride) in the Seair seemed a better way to spend a morning than staring blankly at my computer screen and exercising my mouse aimlessly on its pad in an effort to look busy. So I trundled off to Orlando, Fla., leaving behind a damp and frigid New York. I met the Seair folks at the boat launching site of a small public lake. The boat/plane was packed aboard a single-PWC trailer, the wing rolled up in a 19-ft.-long, 12-in.-dia. bag. It didn't take long to get the craft ready for business. Essentially, you assemble the wing and attach it to the frame that remains fixed inside the boat—about a 20-minute operation.

The Seair uses a 33-ft.-span hang glider-style weight-shift wing for climbs and turns.

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Outdoors

There is no yaw control. A control bar replaces the conventional three-axis control stick/rudder arrangement of a fixed-wing design. Since bar movements produce the opposite effect from a control stick, an experienced fixed-wing pilot has some unlearning to do first.

The rigid inflatable hull (fiberglass bottom with polyethylene foam between the hull and deck) is made to Seair's specs by Patten Inflatables. The stacked 8-in.-dia. main tubes give the flotation of a single 16-in. tube but with reduced surface area (drag) for quicker takeoffs. Twin 5-ft. 10-in.-long tube outriggers are out of the water during normal operation but provide a welcome measure of capsizing insurance, especially during crosswind landing and taxiing. The craft is 110 in. long with a beam of 50 in. The craft weighs 450 pounds and it can carry a load of 450 pounds.

Clambering into the back seat I clasp on a helmet with integral earphones, plug into the intercom and fasten my seatbelt. Pace hits the electric starter to crank the 64-hp two-stroke Rotax 582. The boat vibrates like a giant mixmaster until the engine settles down to a smooth idle. Pace goes through his checklist, taxis out into the lake, turns into the wind and squeezes the trigger throttle. The boat accelerates in a leisurely way but breaks free of the water relatively quickly. Solo, the boat will take off in as little as 50 ft. with a moderate headwind—200 ft. in no wind—and it can climb at 1800 ft. per minute.

While it may look bizarre to gawkers on the ground, a flying boat from the air feels perfectly natural. It's the open-air ultralight kind of flying that requires some adjustment. This thing is totally different from a conventional plane. Pace says "it's the freedom of flying." It may be too much freedom too soon for some. We putter along at a brisk 45 mph. With power, the control bar position is neutral and steering

inputs can be made with one finger. The wing moves around in light gusts and you just ride with it rather than fight it.

Pace kills the engine. There's a loud *Pop!* then silence. The boat seems to hang in the air and then begins a gentle descent. "It's impossible to dive this thing, even with full power and the bar pulled back," exclaims Pace. The wing is a Northwing model Mustang 19 that gives a 10:1 glide ratio and produces optimum lift and speed. It's not "floaty" like larger designs and it will cut through turbulence rather than hang there and bounce you around. The stall break is very mild and stall speed is 25 mph.

We glide down to an uneventful dead-stick landing. A 10-hour



Sans wing, Seair becomes a 50-mph airboat.

instruction course is required before Seair turns over the keys and wishes you bon voyage. Once down, you can detach the wing and the Seair becomes an airboat with a 50-mph capability. But because of its high center of gravity, you don't want to make any fancy turns.

The Seair 2000 is a two-place trainer and it costs about \$26 grand. Single-seat inflatable, innovative land-trike and even amphibious ultralight models are slated to come on stream in the near future with price tags in the \$12,000 to \$15,000 range.

While not faster than a speeding bullet, nor more powerful than a locomotive, and not able to leap tall buildings in a single bound, the unique Seair still qualifies as "Superboat."

For more information, contact Seair Group, 6831 Edgewater Commerce Pkwy., Ste. 1110, Orlando, FL 32810; 888-FLY-SEAIR; www.seair.com.

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EDITED BY CLIFF GROMER

Scan Do

Kodak's new Professional 3570 Plus Rapid Film Scanner creates great high-quality digital files with speed—and it does it at a nice low price. Given its plug-and-play environment, this scanner can be integrated into almost any workplace without hassle, and uses an improved light source that



doesn't require a color filter wheel or IR filter. The 3570 Plus scans color, black-and-white film, positives and negatives, in 35mm, 46mm, 70mm and 120-format film. Retails for \$9500. Contact Eastman Kodak, 343 State St., Rochester, NY 14650; 800-235-6325.

Well Suited

Recycling is a fine idea but lugging recycling bins to the curb tends to dampen our enthusiasm for it. This device is uniquely suited to the task. Appropriately, its heavy-gauge tubing is made from recycled steel. The top rack swivels to keep the recycling bin level as you tip back and roll. Also, the rack is removable, allowing the device to be used as a hand truck. The Caddy-All costs \$70 to \$100, with an average price in the \$80 range. It's sold through home product catalogs. Contact Clipper Products, 675 Cincinnati-Batavia Pike, Cincinnati, OH 45245; 800-543-0324.



Cord-Free Drywall Gun

Whether it's a small drywall job or the tail end of a major project, Porter-Cable's model 9875 cordless drywall driver is sure to be a welcome addition to the job site. Equipped with an adjustable depth-sensitive clutch, the tool is useful for metal frame fasteners and deck construction in addition to drywall work. P-C has powered its 9875 with a Magnequench motor that's claimed to be 10 percent to 20 percent more efficient than standard motors. With its 14.4-volt battery pack, the tool produces 300 watts delivered through two speed ranges of 0 to 600 rpm, and 0 to 2000 rpm. The P-C cordless drywall driver comes in a carrying case with two battery packs, a 1-hour charger, three Phillips bits and a $\frac{1}{4}$ -in. magnetic nut setter. It's expected to sell for about \$250. For more information, write to Porter-Cable, 4825 Highway 45 N., P.O. Box 2468, Jackson, TN 38302.



Mini Multi

Unlike most other multitools that incorporate various implements into a pliers tool, the Mini Grip Swiss Army Knife packs 13 implements, including flat- or needle-nose pliers, into its traditional knife case. The most innovative feature of the Mini Grip is its detachable socket bit holder that holds six different driver tips. The compact 3.25-in. tool features stainless steel implements and has a lifetime guarantee. You can buy it for \$99 at sporting goods stores. Contact Wenger, 15 Corporate Dr., Orangeburg, NY 10962; 800-267-3577.



Stepping Out

Climbing in and out of a high-stance pickup or SUV can be a real workout. To ease the effort, you can either get longer legs or these neat-looking Back Country Tube Steps. Constructed of 3-in. aircraft-grade 304 mirror-polished stainless steel and available with a semi-gloss black powdercoat finish, the steps come with a lifetime warranty against rusting, pitting or flaking. Most applications utilize existing frame holes for easy installation. The tube steps are available through automotive accessories outlets for \$216 (powdercoat) and \$397 (stainless steel). Contact Design Automotive Group, 590 Bond St., Lincolnshire, IL 60069; 800-323-6147.

Label Me Happy

This is what's what in high-tech labeling. The Dymo-CoStar LetraTag is an electronic labeler. Designed mainly for hobbyists and do-it-yourselfers, this electronic labeler includes a color-coded ABC style keyboard, a large display screen and the ability to print up to two lines of text at a time. It also happens to come in some fun colors such as bright blue, green or yellow. You'll be able to use different tapes such as paper, plastic and metallic in a variety of colors and styles. Retail is \$29.99. Contact Dymo-CoStar, 599 W. Putnam Ave., Greenwich, CT 06830; 203-661-9700.



Clean Water For All

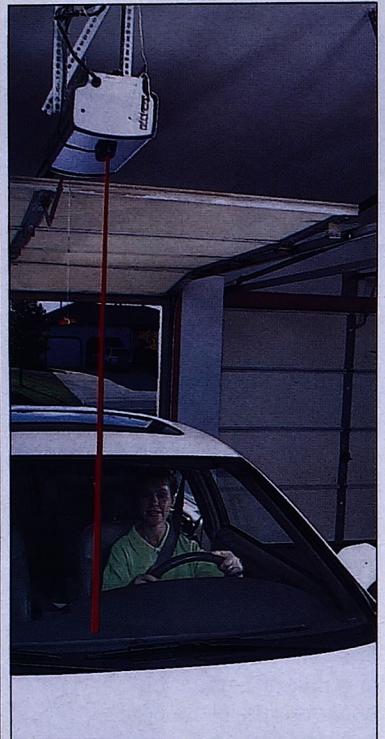
The simple and inexpensive Mission Filter purification system can supply a family of five to 10 with potable water. The unit consists of a pair of 5-gal. buckets, lids, filters and fittings. To destroy disease-causing organisms, contaminated water is mixed with household chlorine bleach in the top bucket. It then passes through activated charcoal and polypropylene filters. Safe-to-drink water is dispensed through a spigot on the bottom bucket. Sold for about \$50 by Eagle Spring Drinking Water Systems of Holly Hill, Fla. (800-881-7620), the Mission Filter is designed for disaster relief areas and as a household emergency system.



Great Stuff

Down To Earth

Even if it looks like it should be cutting turf in outer space, Yard-Man's 20-hp. tractor is a down-to-earth machine. To drive it, move the console shift lever into Drive or Reverse and step on the pedal. The further you press, the faster the tractor goes up to its top speed of about 5 mph. Below the tractor is a 46-in., three-blade deck that mounts and removes without tools. The turning radius has been reduced by nearly a third compared to previous models, due to automotive-like geared steering and a caster-camber wheel design that also improves tire wear, increases the machine's straight-line steering stability and reduces turning effort. It costs about \$2000 at home centers. Contact MTD, P.O. Box 368022, Cleveland, OH 44136.



Stop Light

The "thud" method of parking in your garage may have its merits, but the Car Stop precision parking system can help cut down on

those whiplash bills. Mounted on your garage door opener or ceiling, the system projects a bright red laser

dot on your dash to tell you when you've gone far enough. Car Stop works on low power seconds after you activate the garage door opener. It sells for \$29.95 from Pedestal, 1114 E. 6th Ave., Emporia, KS 66801; 800-550-8425; www.pedestalcorp.com.



Wake Maker

Toyota wants to make waves with its new Epic X22 wakeboard boat. Based on the open-bow Epic 22 recreational model, the X22 features an integrated tower, a 70-gal. ballast system with pushbutton pumping, and new interior and exterior design. The multievent hull has two tracking fins for stability, while the marinized Lexus V8 coupled to a Hurth transmission moves things along with 300 hp and 310 ft.-lb. of torque. The X22 is available through Toyota Marine dealers for \$35,575. For more information, call 1-800-975-EPIC; www.marine.toyota.com.



What To Do

What do you do when you need to trim, but a string trimmer really doesn't do what you want? One option is to use Stihl's FH 75 power scythe. Think of it as a cross between a string trimmer and a hedge trimmer—at the end of its 59-in.-long shaft is a 12-in.-long reciprocating cutter head that adjusts from 0° to 90°. It's designed to cut anything from tough, fibrous plants to ordinary grass. Unlike a string trimmer, it doesn't throw the cut vegetation aside. The vegetation falls over as you mow along. It costs about \$570 at Stihl dealers. Contact the company at P.O. Box 2015, Virginia Beach, VA 23450.



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Great Stuff

A Ground-Breaking Product

If you've been waiting for a four-cycle minitiller to break into the market, give this product a look. The Honda Harmony FG100 is powered by a tiny 35cc four-cycle engine that produces 1½ hp. The fact that it's small, weighing slightly less than 27 pounds, and is powered by a four-cycle engine could make it a good fit for homeowners with small yards and a four-cycle lawnmower. Honda chose a rugged worm gear transmission to transmit power to its four fine blades. The machine tills a 9-in. width, and Honda says that it's agile enough to till within 1 in. of plants. It comes with a carrying handle and a pair of transport wheels. Aerator blades, a border-edger attachment and a dethatcher are available as accessories. It costs about \$350 at Honda outdoor power equipment dealers. Contact American Honda Motor, River Green Pkwy., Duluth, GA 30096; 800-426-7701.



More Grip—Less Slip

Craftsman adds a new twist to the old adjustable wrench with its Craftsman Clench Wrench. With the tool's spring-loaded self-adjusting jaw, the harder you pull, the tighter it grips. The self-ratcheting feature maintains continuous contact with the fastener on its flats, not its corners. The 8-in. Clench Wrench costs \$19.99 and handles ¾-in. to 1⅜-in. (10mm to 18mm) fasteners. A 10-inch for \$24.99 handles ½-in. to 1-in. (13mm to 25mm) fasteners. The set costs \$39.99 at Sears stores. Check it out online at www.sears.com/craftsman.



Help In A Tight Spot

For a homeowner, plumbing can be a real backbreaker. Enter Speedi Plumb Plus braided hose connectors. They consist of an inner hose of extremely tough and flexible rubber. The hose is protected by a braided plastic jacket that resists just about any household chemical that comes its way. This construction makes the connector more flexible than those made from stainless steel hose, says the manufacturer, making it ideal in tight spots. You can get one to make just about any connection, from faucets, toilets and washing machines to water heaters, ice makers and humidifiers. The connectors are approved by IAPMO (the International Association of Plumbing and Mechanical Officials). They range in price from \$7 to \$19 at hardware stores and home centers. Contact PlumbShop, 39600 Orchard Hill Place, Novi, MI 48375.



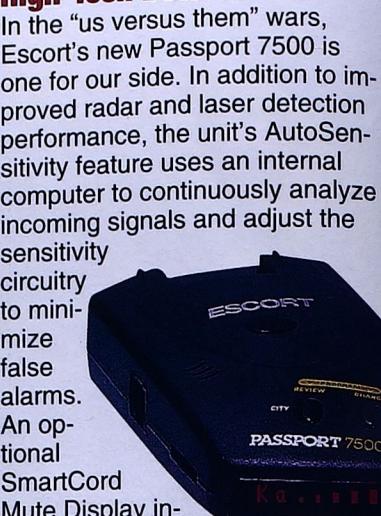
High-Tech Detector

In the "us versus them" wars, Escort's new Passport 7500 is one for our side. In addition to improved radar and laser detection performance, the unit's AutoSensitivity feature uses an internal computer to continuously analyze incoming signals and adjust the sensitivity circuitry to minimize false alarms. An optional SmartCord Mute Display incorporates the alert display and mute button on the lighter power plug, allowing the detector to operate in the dark mode for discreet night driving. The Passport 7500 is available for \$229.95 (SmartCord is \$29.95 extra) direct from Escort, 5440 West Chester Rd., West Chester, OH 45069; 800-588-4961.

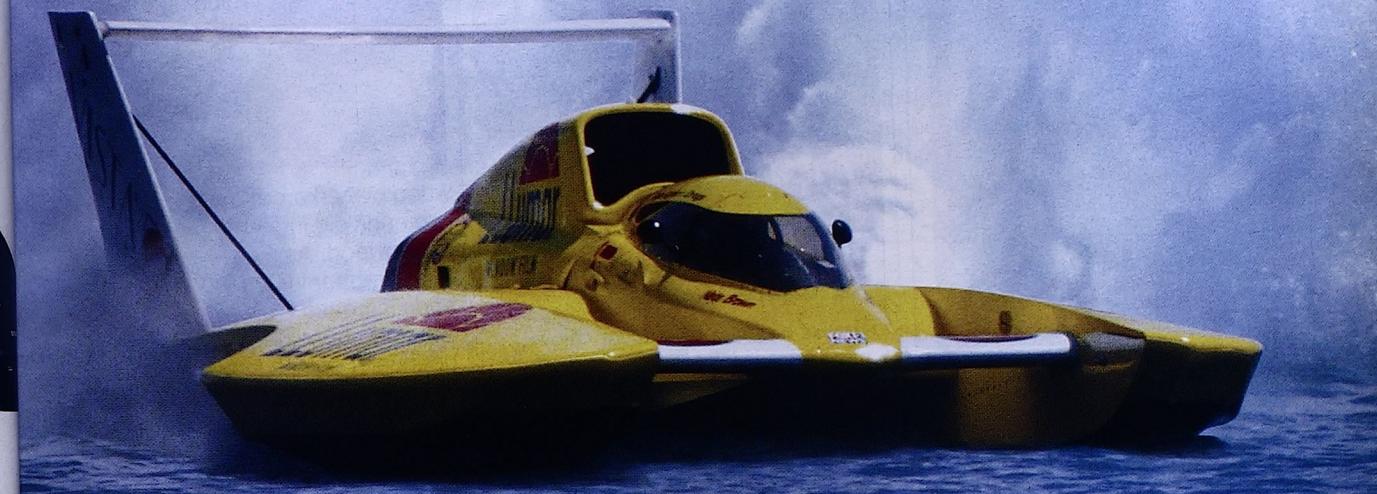


Slush Busters

Most folks today wouldn't be caught dead wearing a pair of ugly galoshes. The new overshoe to keep you in step when foul weather, snow or slush are out to attack your favorite dress shoes or sneakers is called New England Overshoe. Unlike traditional overshoes, these waterproof slipovers, available in a variety of models, provide warmth, traction and style. And many scrunch up to store in your bag or briefcase. The overshoes sell for \$39.99 to \$84.99 depending on the model, and you'll find them at outdoors stores and in catalogs. Contact New England Overshoe, 176 Battery St., Burlington, VT 05401; 888-289-6367; www.overshoe.com.



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A person wearing camouflage clothing and a matching cap, standing outdoors. The person is wearing a camouflage shirt and pants, and a camouflage baseball cap. They are standing in front of a white wall with some greenery visible on the right side.

Great Stuff

Get A Grip

The Stanley StudGrabber is a new solution for hanging tools and equipment out of the way. The StudGrabber is a piece of corrosion-resistant wire bent so that

when placed around a 2 x 4, the two ends dig into and grip the sides of the wood. As weight on the StudGrabber increases, the wire ends increase their grip. A single StudGrabber safely holds up to 25 pounds. It comes in two models: a single utility hook (model 81-9215), and a double-pronged hanger (model 81-9250) for shovels and rakes. StudGrabbers can also be hooked to overhead joists for attic storage and are ideal temporary hangers for the job site. StudGrabbers are available in packs of six for under \$18 at home centers and hardware stores. Contact The Stanley Works, 1000 Stanley Dr., New Britain, CT 06053.

Hide And Seek

Camo clothing takes the next step with the Deceptor Collar dickey hat provides total concealment when worn with regular camo gear. Made of a tight knit stretch fabric, the Deceptor covers the entire area from chest to cap when in conceal mode. The dickey snugs up to your face, hugs your neck, seals out bugs and seals in body heat. When concealment isn't required, it folds down to a conventional turtleneck collar. The Deceptor costs \$14.95 from Two Painted Ponies, 7616 Dover Ln., Fort

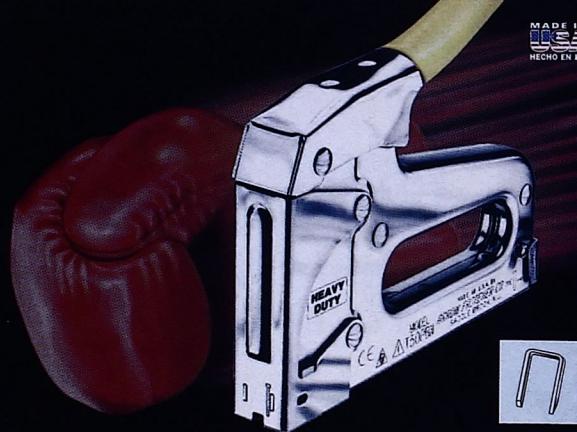
Great Stuff

Bright And Shiny

Newly painted siding looks fresh and attractive until mildew sets in. Zinsser introduces Perma-White, a tintable bright white 100 percent acrylic resin paint with a five-year mildewproof guarantee. It resists mildew by forming a tough, dense, flexible and glossy paint film, Zinsser says. The paint prevents dirt and mildew spores from sticking, and its gloss and density allow dirt to simply wash off with the rain. Its toughness makes it resistant to weathering. The paint's second line of defense is a slow-release mildewcide that kills mildew over the paint's service life. A gallon costs about \$25 to \$29 at hardware stores, paint stores and home centers. Contact William Zinsser & Co., 173 Belmont Dr., Somerset, NJ 08875.



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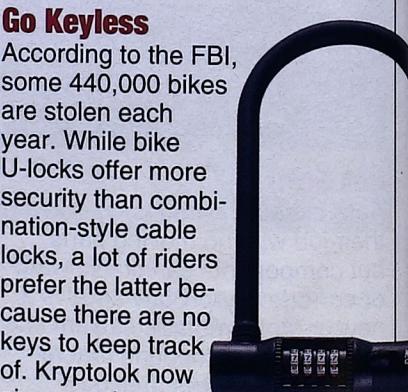
TURANZA REVO

Gripper

Most tires lose wet traction performance as they wear. Bridgestone's new Turanza Revo uses several technologies to enhance wet traction. A special rubber compound reduces the effect of friction-related rubber hardening—one of the causes of reduced wet traction. A dual-layer tread uses a layer of high-grip rubber beneath the tread blocks. As the tread wears, it exposes the high-grip rubber that offsets the effects of wear on wet braking and handling. The new tires are available in H-, V- and Z-ratings in 14-in. to 17-in. sizes. Prices range from \$97 to \$276 each at all Bridgestone/Firestone tire dealers. Call 800-807-9555 to find the nearest dealer.

Go Keyless

According to the FBI, some 440,000 bikes are stolen each year. While bike U-locks offer more security than combination-style cable locks, a lot of riders prefer the latter because there are no keys to keep track of. Kryptolok now gives you both the security of a 4 x 8 x 1/2-in.-dia. hardened carbon-alloy steel U-lock and a resettable four-digit combination locking mechanism. The lock weighs less than 2 pounds, comes with a bike bracket and costs \$31.95 at bike dealers and sporting goods stores. Contact Kryptonite, 320 Turnpike St., Canton, MA 02021; 800-SAY-LOCK; www.kryptonitelock.com.



Clean It First

In some respects surface preparation is worse than actually painting a surface. Liquid TSP Substitute is a product formulated to make the job a little easier by allowing you to wipe a surface clean then move on to the next area without having to rinse.

One quart of the cleaner can be diluted to make 4 gal. of cleaner, or enough cleaner to wash 1600 sq. ft. of surface or a smaller area if a more concentrated solution is called for. If trisodium phosphate (TSP) is not available in your area, the product is well worth considering. A quart costs about \$5, and a gallon \$15, at hardware stores, paint stores and home centers. Contact Savogran, 259 Lenox St., P.O. Box 130, Norwood, MA 02062; 800-225-9872.

Two-fer Tiller

It would be nice to have two tillers. You could use a rear-tine model for heavy sod busting and tilling, and a front-tine machine for cultivating and yard-work. You can come pretty close to this ideal with Versa Tiller, a 5-hp, 12-in. tiller with handles that swing through 180°, allowing it to be easily converted from a rear-tine model to a front-tine model. With two accessories that cost about \$30 each, the \$800 machine can be converted into an edger or an aerator. Also increasing its versatility is its adjustable tilling width. Remove the outside tines and the machine tills a 7 1/2-in.-wide swath. It's sold at Troy-Bilt dealers and directly from the factory. Contact Troy-Bilt, 1 Garden Way, Troy, NY 12180; 800-828-5500.



Ride The Wave

Bose has introduced its new Wave Radio/CD, a simple touch-controlled device giving you clock and radio features as well as CD functions. The company's waveguide technology produces accurate sound from an extremely small enclosure, where no dimension is over one-quarter of an inch. Also interesting is its ability to connect to any Bose-powered loudspeakers to become the center control for a full high-fidelity system. Retail is \$499. Contact Bose, The Mountain, Framingham, MA 01701; 800-919-BOSE.



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by Sarah

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2
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3
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If you ride a motorcycle or scooter, you need all the visibility you can get—especially from behind. The Helmet Brake Light attaches to the rear of your helmet, baggage or top case to give you an additional brake light. It uses a cordless connection to your bike's brake light and it is activated whenever you apply the brakes, even if your bike's brake light bulb is burned out. The light system sells for \$75 from Hercules JPR, R.R. 1, Box 1416, Stroudsburg, PA 18360; 800-800-4920; www.safedriving.com.



Out Reach

You've got a shortbed pickup and you've got to haul a longbed load. No problem. Extend-A-Bed is a platform extender with stake pockets that installs in a standard 2-in. receiver hitch in less than 5 minutes.

The platform extends 3 ft. beyond the tailgate, giving you a 23-sq.-ft. work platform or extension for long loads. Extend-A-Bed sells for \$449.95 and the optional aluminum sides shown here add \$289.95. Steel sides cost \$179.95. Contact Extend-A-Bed, 1445 Bender Rd., Chaska, MN 55318; 877-398-3632.



Don't Give Crooks A Brake

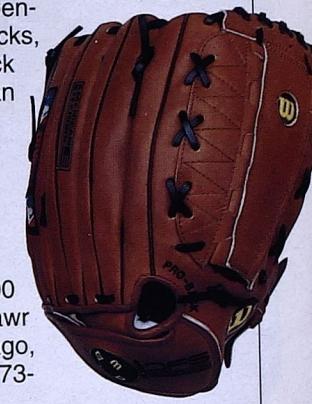
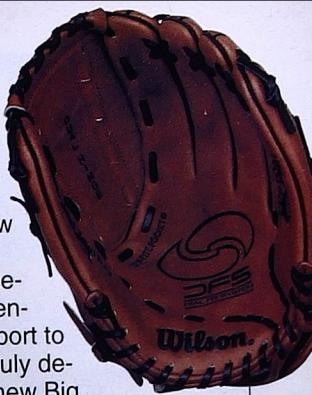
Many steering wheel antitheft locks can be defeated by cutting the steering wheel, typically a thin metal core covered by foam padding. But the UnBRAKEable AutoLock slides over the top of the brake pedal arm and locks the pedal. Nothing connects to the steering wheel. AutoLock is forged from hardened steel and has a protective coating. Brake pedals are made of solid steel and are almost impossible to cut. It fits most cars and trucks, and costs \$59.95 at mass merchandisers. Contact Lawman Armor, 1434 Sugartown Rd., Berwyn, PA 19312; 610-296-1948.



Glove Me Tender

It's spring, and you know what that means—baseball! And to enhance this sport to the glory it truly deserves, the new Big Sweet Spot design is being added to Dual Fit System (DFS) gloves DFS3 and DFS4—offering a 15 percent larger prime catching area. These gloves also feature hard openings and backs, and soft thick leather for an easy break-in period.

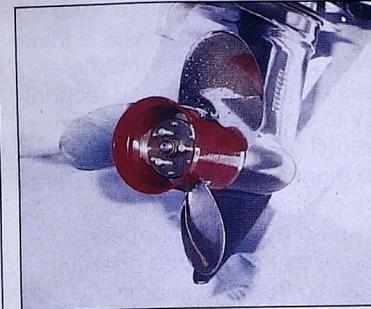
Retails for \$131. Contact Wilson Sporting Goods, 8700 W. Bryn Mawr Ave., Chicago, IL 60631; 773-714-6400.



Switch Pitcher

Some boaters keep a collection of props for different boating needs. Now all they need is one—the Vari-Prop adjustable propeller. Operated from the helm, the prop can be set on automatic, which adjusts blade angle for optimum performance. The fixed max pitch setting gives you top speed. The shifting range is from 24 in. to Reverse, and the three-blade

prop mates to any standard spline configuration. The prop uses self-contained hydraulics and will work with outboard and sterndrive engines. It sells for about \$1200 at marine outlets. Contact Vari-Prop International, P.O. Box 1856, Cottonwood, CA 96022; 530-347-6122.



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Portable watercraft take on new practicality with the Puffin foldable kayak. Weighing only 19 pounds, the 10.5-ft. boat can be stuffed into a 28 x 12 x 12-in. duffel. Made up of a heavy-duty skin stretched over a framework of anodized aircraft-grade aluminum, with inflatable compartments, Puffin will carry 250 pounds of cargo, and is easier to paddle than inflatables. The kayak costs \$799, making it one of the least expensive folding boats. Contact Scan Sport, P.O. Box 700, Enfield, NH 03748; 603-632-9500; www.pakboats.com.



Tooling Along
Hulk Hogan might be able to carry all the tools for his car, but for the rest of us there's the new Craftsman three-in-one Rolling Workshop. Even the proverbial 98-pound weakling can easily roll everything including air tools in the Workshop's deep storage bin. Above the bin is a toolbox with two slide-out drawers. A removable cord reel will hold a 50-ft. extension cord. The Workshop rolls on 4-in. wheels and has a telescoping handle. You'll find it at Sears outlets for \$59.99. Learn more online at www.sears.com/craftsman. **PM**



Great Stuff



Hot Times

You'd be surprised at how temperature can help as a diagnostic tool in troubleshooting brakes, ignitions, cooling systems and electrical systems. Raytek's Mini-Temp pocket-size thermometer uses noncontact infrared technology to do just that. Simply aim the unit from up to 6 ft. away, pull the trigger and read the temperature on the display. The unit, powered by a 9-volt battery, measures the infrared energy radiating from the source. MiniTemps cost \$99 (\$139 with laser sighting) at auto parts outlets. Contact Raytek, P.O. Box 1820, Santa Cruz, CA 95061; 800-866-5478.



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Technology

IN THE PALM OF YOUR HAND

Be connected to the Internet from anywhere with new wireless personal digital assistants.



► As power tools for road

warriors, personal digital assistants (PDAs) have gone as far as they can go with addresses, to-do lists and calendars. Next stop: cyberspace. Later this year, market leader Palm Computing hopes to deliver a smooth wireless path to the Internet, a goal that's eluded several PDA manufacturers who have come up with unwieldy cellphone-to-PDA and PC card modem systems in the

past. New Windows CE-based Palm-size PCs are taking the wired road to the Internet for now, offering support for audio players, video viewers and Web-browsing services that strip down content for a PDA.

Not only are personal digital assistants making better use of the Internet, they're also taking on new looks and configurations as Palm wannabes try to reshape the popular Pilot concept in their own image. Dictaphone wants a piece of the handheld action and has built a PDA into a portable voice recorder. Qualcomm is spinning off a new hybrid category that squeezes a PalmPilot and a wireless phone into the same handheld device. Microsoft Palm-size PC supporters have juiced up second-generation products with color displays to support their multimedia push. Even the old PalmPilot is getting a facelift. The new Palm V is

BY REBECCA DAY
Photo by Barry Blackman

dressed in a streamlined anodized aluminum case that's thinner than the Palm III by nearly half.

Is anyone going to buy these pricey personal companions? It's a fertile market, according to research from International Data, which predicts that 2.6 million of the devices will be shipped this year, shooting up to 5.2 million in 2002. At \$500 and up, some of the new PDAs are testing the limits of user budgets for devices that don't have a keyboard or a smooth means for inputting text. Will new attributes be enough to make costly PDAs indispensable companions? Possibly. Here's what's coming your way.

Palm V

With all the Pilot look-alikes on the market, Palm had to do something to set itself apart. Its response is the \$449 Palm V, a slimmed-down, superstyled version of the Palm III that weighs just 4 ounces, about half as much as other PDAs. Palm V is framed in an anodized aluminum case and comes with a leather cover. Under the hood, the Palm V packs 2MB of RAM, enough to store the addresses of 6000 of your closest friends, five years of appointments, 1500 to-do items, 1500 memos and 200 e-mail messages—plus applications from third-party suppliers. Palm V may look a bit understated when placed next to a next-generation palm-size PC with its splashy color screen, but you can expect days more use

from the Palm V's rechargeable lithium-ion battery.

Qualcomm pdQ

Like any cellphone, the price for the Qualcomm pdQ will be set by the phone retailer, but market watchers peg the tag at between \$500 and \$1000. The lower end of the range wouldn't be a bad deal since the de-



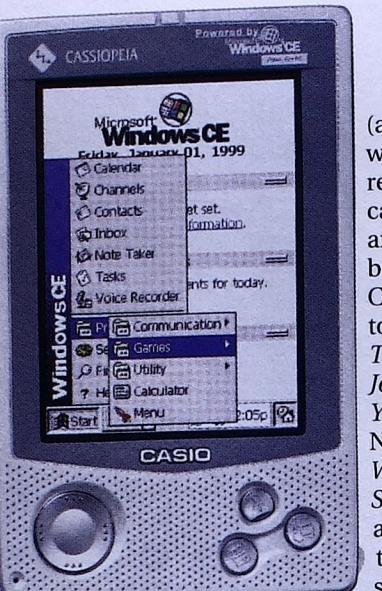
QUALCOMM
pdQ

juggle between your PDA and phone to find a phone number and make a call. No one there? Tap on the e-mail address and punch out a short message on the virtual keyboard. You can browse the Web, too, though the sluggish download rate of 13.2Kbps means you'll be burning time and money on your pricey cellular network.

Casio E-100

Response time is crucial in a PDA, and Casio's 131-MHz engine gets you in and out of applications quickly compared to other palm-size PCs, which drive at 100 MHz or less. Three programmable buttons store your favorite apps and an action wheel lets you thumb through files quickly. You can also navigate with the cursor pad. The \$499 E-100 boasts 65,000 colors, compared with 256 on other units.

There are 16MB of RAM and a CompactFlash slot, which will accept a 56K modem in the future. An Audible player isn't built in but support for it comes with the latest version of Windows CE, and you can download one for free from the Casio Web site



CASIO E-100

Look for an optional multimedia pack (\$69) bundling an MP3 audio player and an MPEG movie player for playing back brief video clips of movies or TV shows. A 56Kbps CompactFlash modem is available separately for \$199.

Philips Nino 500

Philips likes to show off its speech-recognition talents and it's the only palm-size PC company to include voice command and control software as a basic feature of its product, rather than as an add-on. You can launch an application or open a file by speaking a command such as "calendar" or "e-mail." Nino 500, which lists for \$499, steps up to 16MB and 256 colors from 8MB and a monochrome display in the previous version. Color and memory come in handy for viewing JPEG im-

(along with \$50 worth of Audible recordings). You can also download an AvantGo Web browser from the Casio site for access to information from *The Wall Street Journal*, *The New York Times*, CNET's NEWS.COM, *InfoWorld* and *The Sporting News*, all in a format tailored to the small screen size.

ages on the embedded picture viewer. You can also use the extra capacity to store audio downloads from the Audible player that's built into the unit. From Audible you can download spoken versions of books, articles and radio programs for later playback, using either the headphone jack on the unit or a car cassette adapter. Nino will also play MP3 recordings downloaded from other Internet sites. Also included: an AvantGo Web browser, CompactFlash slot, printer and fax software, and Calligrapher, a handwriting recognition program.



PHILIPS
NINO 500

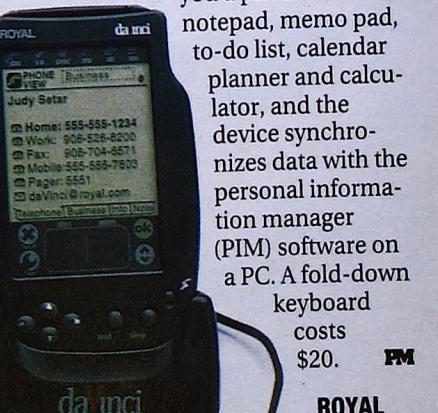
ing tax battery power big time. Compaq estimates you'll get 7 to 10 hours of battery life from the supplied rechargeable lithium-ion battery. Compaq's ergonomic goal with Aero is one-handed operation. The \$499 device packs a one-touch Record button for short memos. Beneath it is a rocker switch that scrolls easily between applications. Push in the rocker when the cursor hits the application you want. You can program four customizable buttons for your favorite applications.

Aero comes with a built-in Audible player, a picture viewer for JPEG files, a headphone jack and a CompactFlash expansion slot for future third-party applications such as one-way paging, modems and local area network cards. It ships with 16MB of RAM, a docking station, a car adapter for playing Nino content through a car stereo system and a palette of software titles that includes a power calculator and a business expense tracker.

Dictaphone

How does a company known for voice recording jump on the e-mail bandwagon? Combine the two and start pushing "voice e-mail." That's Dictaphone's strategy with its \$449 Walkabout Quest and the company has thrown in a synchronizing organizer for good measure.

The Walkabout Quest PDA has no modem, though, so it has to be linked to a PC for communications capability. You create a



ROYAL
DAVINCI



COMPAQ AERO

Compaq Aero

Use Aero inside or out, thanks to reflective screen technology that makes the LCD as visible under fluorescent indoor lighting as in outdoor light. Go easy on the backlight on the Aero, or any of the color PDAs, because color and backlight

For More On Technology

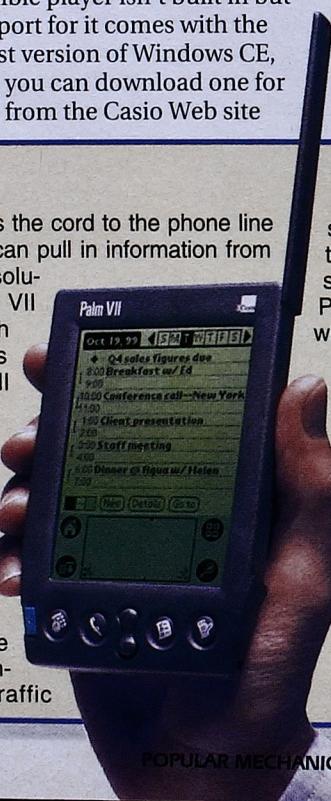
Check the Technology channel on the PMZone Web site at <http://popularmechanics.com/popmech/elect/1HOMELECT.html>

"Researchers predict that 2.6 million PDAs will be shipped this year, shooting up to 5.2 million in 2002."

3COM PALM VII

The two-way radio inside the Palm VII cuts the cord to the phone line and the PC. With current palm PCs, you can pull in information from the Web through wired modem add-on solutions or direct PC connections, but Palm VII (\$800) does it wirelessly over the BellSouth data network, which extends to 260 markets nationwide. Currently in field trials, Palm VII is designed to provide fast and easy access to Internet Web sites and company intranet sites, along with e-mail.

To make Internet content work on a PDA, Palm uses "Web clipping" to extract necessary information from a given Web site and weed out extraneous data such as images, which slow down access time and clutter the screen. The system works on a query-and-response format. Enter data for information you're interested in—a stock quote, or local traffic



info—and the compressed information appears in under 10 seconds. Monthly subscriptions for clips and e-mail over the Palm.net network start at \$10 for 250 screens of information—e-mail or data. Palm VII will ship with 22 applications, which are launched by tapping icons on the screen.

Applications include Bank of America home banking, E*Trade quotes and trading, MasterCard and Visa ATM locator service, various news and sports providers, a Merriam-Webster dictionary and thesaurus, UPS package tracker, U.S. West Yellow Pages, Yahoo people search, Etak real-time travel information, Frommer's and Fodor's travel guides, Moviefone, Official Airline Guide, TicketMaster, Travelocity flight information and The Weather Channel.

Automotive

VIPER VS VETTE

America's sports cars are road racing again.

BY JIM McCRAW

Just when we thought that participation in big-time road racing was kind of a dead issue in Detroit, along comes a seriously renewed interest on the part of not one but two automakers. The company formerly known as Chrysler had been supporting its Viper GTS with a real factory-backed purpose-built race program,

MOTORSPORTS the GTS-R. Now things will get some added spice this season and next thanks to the arrival of the officially supported Chevrolet Corvette C5-R.

How much are the Vette and Viper road racers alike and how much are they like the Vette or Viper you may see down at the local dealer? Read on.

Corvette C5-R

Chevrolet debuted the new C5-R factory race car at last November's Specialty Equipment Manufacturer's Associa-



VETTE C5-R



VIPER GTS-R

tion (SEMA) Show in Las Vegas. The C5-R was designed and built to compete in FIA GT2 sprint and endurance races against the Porsche 911, BMW 3 Series and, of course, the Dodge Viper GTS-R—campaigned by professional factory teams. Still teething, the Corvette C5-R race car is a Pratt & Miller Racing design, built at the firm's shop in Wixom, Mich., near Detroit.

Pratt & Miller started 18 months ago with a completely stock C5 Corvette. They tore it down to its most basic components, and built it back up into a pure race car, slightly longer, lower and wider than a production C5. The stock C5's 104.5-in. wheelbase stretched to 104.7 in. The length was stretched from 179.7 in. to 182.8 in. overall. The C5's stock height of 47.8 in. was lowered to 45.8, and the car's width was stretched from the stock 73.6 in. to 76.4 in.

Canadian Trans-Am racer Ron Fellows is the lead driver, along with veteran road racers Chris Kneifel and John Paul Jr. A second team, from the Riley & Scott race shop in Indianapolis, also runs a C5-R with drivers Scott Sharp, Andy Pilgrim and GM engineer/racer John Heinricy.

The C5-R uses a specially built 6.0-liter small-block V8, with a 4.125-in. bore and a 3.42-in. stroke for a total of 365 cu. in. The stock Corvette's aluminum small-block engine has a 3.90-in. bore and 3.62-in. stroke, with 10.5:1 compression, making 345 hp, while the race engine's output is at least 600 hp at 7200 rpm with 495 ft.-lb. of torque at 5600 rpm.

The racing engine's block has larger water passages than a stock block. The reciprocating assembly is based on a Moldex billet crank, Carillo connecting rods and JE forged racing pistons. The cylinder heads have been altered extensively from stock, with 12.5:1 compression. The valvetrain uses a Competition Cams grind on a Chevrolet camshaft blank. Chevrolet chose Iskenderian lifters, Fox pushrods and Jesel 1.9:1 rocker arms to complete the valvetrain.

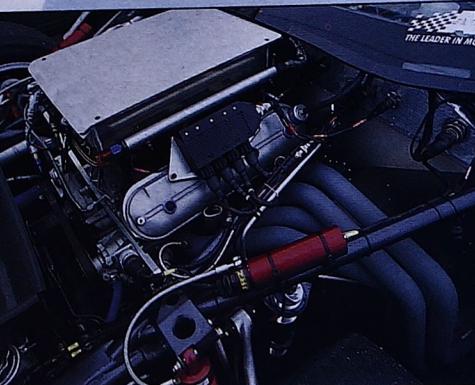
A Kinsler racing fuel-injection system, with elaborate cross-ram air horns and a composite airbox between the engine and the hood, breathes through

an air intake behind the headlamps. An aluminum motor plate mounts to the front of the block, with a structural aluminum oil pan and a modified stock aluminum front subframe. The engine uses an external mechanical three-stage oil pump and dry-sump lubrication with the oil tank under the fuel tank.

A five-speed Hewland racing transmission replaces the standard six-speed, mounted ahead of the differential. The balance of the drivetrain includes a 5.5-in. triple-disc Tilton carbon clutch, and a Pratt & Miller 3.11:1 rear end with Metalore axles and CV joints.

The electronics package includes two Delphi Electronics engine computer-and-ignition systems and a complete Pi Research Systems 6 dashboard display, data acquisition and telemetry system that includes motion sensors on the front and rear suspensions.

The C5-R factory race car is based on the stock Corvette's hydro-formed frame rails, stock front and rear aluminum subframes, stock front upper and lower control arms, and stock rear lower control arms. The standard rear



Corvette C5-R has a small-block V8 that's hand-built

by Pratt & Miller. The race motor makes about 1½ as much power as stock. The C5-R weighs about 20 percent less than stock. The instrument panel is pure high-tech racer. With a full complement of Pi Research Systems and Delphi Electronics, data acquisition is not an issue.

upper control arms are new, fabricated by Pratt & Miller to clear the Alcon aluminum racing brakes.

Instead of fiberglass, the C5-R's body is carbon-fiber composite. And the C5-R weighs 2510 pounds rather than the stock car's 3245. A new air intake system for engine cooling has a scoop positioned above the deep

front spoiler, and the body has lowered sills to house the 4-in. exhaust pipes. The roof has a forward-facing scoop for driver ventilation, and a NACA duct to the rear for the transmission and differential coolers.

There's a three-element adjustable aluminum rear spoiler. The stock 19.1-gal. fuel tank was changed to a 26.4-gal. or 100-liter fuel cell for racing, with dual electric fuel pumps. A one-piece composite front end carries a Davis aluminum radiator and carbon-fiber ducting to exhaust hot air through hood louvers.

Where the stock Corvette has short- and long-arm front suspension with forged aluminum control arms, the race car has the same basic setup with forged upper and cast lower arms with a fabricated steel knuckle, triple-adjustable JRZ coil-over shock units (high- and low-speed jounce plus rebound) and an adjustable stabilizer bar. At the rear there are short and long arms with fabricated-steel upper and cast-aluminum lower arms, a fabricated steel knuckle assembly, three-way adjustable JRZ coil-over shock units and an adjustable rear stabilizer bar.

As for rubber, the race setup requires Goodyear Racing Eagle 25x19x18 front tires and 28x12.5x18 rear tires on BBS forged magnesium center-lock wheels. These are



At The Club Level: Dodge Viper ACR

The Dodge Viper ACR (for American Club Racer) is a racing version of the Viper GTS street car that's a \$10,000 option over and above the \$68,900 price of a Viper GTS.

When you start out with 460 hp and 500 ft.-lb. of torque, you don't need much else, so the Viper ACR is not a radical car by any means. Power was increased, weight was trimmed down wherever possible, and handling was further refined for track use on racing tires.

There are several items in the 1999 MoPar parts catalog specific-

ly for the Viper ACR. Complete engines are available through MoPar Performance, already assembled and blueprinted by the factory, making closer to 500 hp.

Dodge already has a Viper ACR technical assistance hotline in place for help on race setups, and will publish lists of frequently asked questions and answers to help the first group of Viper ACR racers. There will also be a contingency program that will pay cash prizes to those who win the T1 class at SCCA races with a Viper ACR.

—J.M.



"Chevrolet designed the Corvette C5-R to race against Viper GTS-R in serious competition."

stopped by Alcon 15x1.38 front rotors and 14x1.26 rear rotors, yielding 635 sq. in. of braking area for the race car versus 421 for the street version, a 51 percent increase.

Dodge Viper GTS-R

Back in 1995, Chrysler introduced the Dodge Viper GTS-R, a limited-production racing car intended for FIA GT-class competition. The standard powertrain was a 525-hp 8.0-liter V10, with 650- or 750-hp engines available as optional equipment. It was designed to be a serious competition car for the world's greatest races, the 24 Hours of Daytona, the 12 Hours of Sebring and the 24 Hours of LeMans. The GTS-R was a factory-built race car for professional racing teams. The Viper GTS-R won the prestigious 1997 FIA GT2 championship and the 1998 24 Hours of LeMans in the GT2 Class. It was the first production-based car from an American manufacturer ever to win the French classic.

GTS-R competes in international road racing in the same GT2 class as the Corvette C5-R, with a much larger engine and a much larger aerodynamic profile.

The Viper GTS-R came in first and second in class at the 24 Hours of LeMans in 1998 and won its class title two years in a row in the hands of the French ORECA team run by Hugues de Chaunac from his shop in southern France. ORECA drivers include Briton Justin Bell, Americans David Donohue and Tommy Archer, French driver Olivier Beretta, Italian Luca Drudi, Portuguese Pedro Lamy and Austrian Karl Wendlinger.

The GTS-R bodywork is carbon fiber like the Corvette's and the car weighs only 2650 pounds. It sports

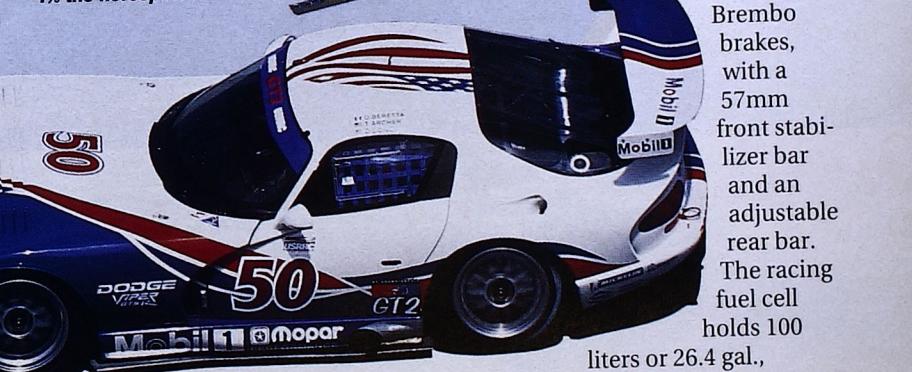
a huge standoff rear spoiler, side exhausts, a roof vent and two pairs of extra driving lamps built into the carbon-fiber nosepiece for night racing. The first GTS-Rs were designed and built at Chrysler headquarters in Auburn Hills, Mich.

headers. Lubrication has been changed over from wet-sump to a four-stage Caldwell pump and dry-sump system with a 12-quart remote tank. It drives through a three-disc 7.25-in. Tilton racing clutch with a Borg-Warner six-speed transmission and a 9.75-in. Dana 60 aluminum rear end with racing halfshafts and CV joints.

The GTS-R is equipped very much like the Corvette, with a roll cage, a space frame and a flat bottom. The suspension uses stock aluminum wishbones with Dynamic coil-over shocks, R&S hubs and modified stock knuckles to mount larger bearings



Viper GTS-R runs on a competition version of the 8.0-liter V10 putting out as much as 750 hp. The carbon-fiber body is wrapped around a roll cage, space frame and full-race suspension. The GTS-R weighs more than 20 percent less than a stock GTS and can have 1½ the horsepower.



and the Brembo brakes, with a 57mm front stabilizer bar and an adjustable rear bar. The racing fuel cell holds 100

liters or 26.4 gal., restricted by class rules.

The GTS-R uses 12x18-in. front and 13x18-in. rear OZ center-lock alloy wheels and Michelin Pilot SX slicks with Brembo six-piston 15-in. carbon/metallic front brakes and four-piston 14-in. carbon/metallic rear brakes.

Eight customer cars will be built for 1999, two using the proven ORECA chassis from last year and six more brand new from the ground up. All eight are spoken for, at an average price of \$325,000 each, ready to race.

For More On Motorsports

Check the Automotive channel on the PMZone Web site at <http://popularmechanics.com/popmech/auto2/1HOMEAUTO.html>

Science

THE MACHINES OF STAR WARS™ EPISODE I THE PHANTOM MENACE™

We lift the hood and pull back the access panels on the most amazing land- and spacecraft George Lucas has ever imagined.

BY JIM WILSON, Illustrations by Richard Chasemore and Hans Jenssen

■ Crammed into the subway-tight

elevator, it occurs to us that there isn't a 12-year-old boy on the planet who wouldn't trade his best sneakers to be in our shoes. "Half of the people who work here don't even know this place exists," says our escort as she turns a brass key in a lock on the control panel. "They don't know

COVER STORY there is a third floor." Even the CIA marks its elevator buttons. But then, they're not hid-

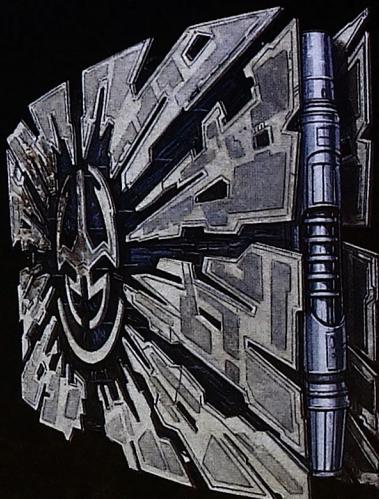
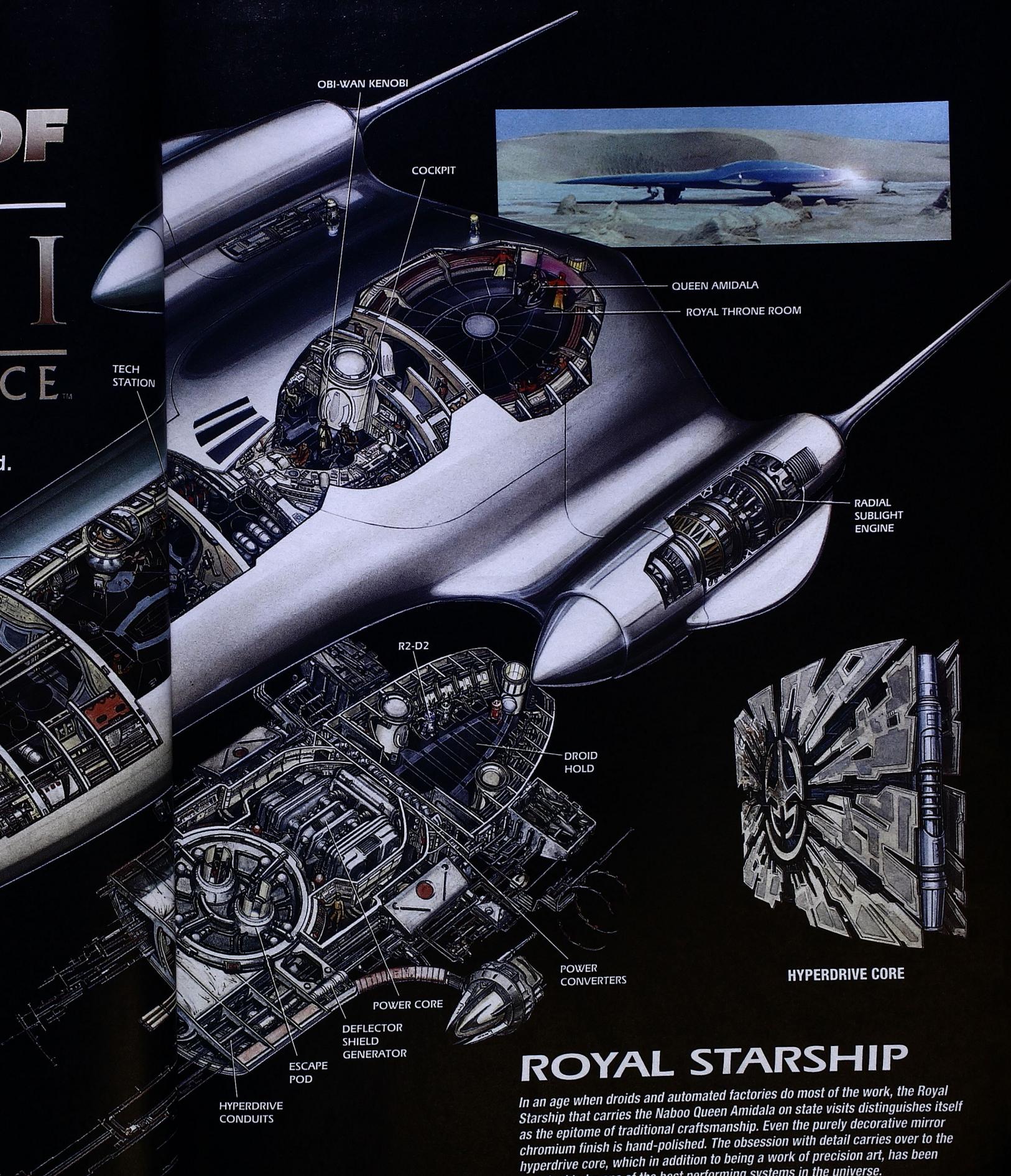
ing a billion dollars' worth of alien technology. "Star Wars" creator George Lucas has invited POPULAR MECHANICS to Skywalker Ranch, just north of San Francisco, and given us unprecedented access to the Lucasfilm design studio. For the next few hours we will be lifting the hoods and kicking the tractor beams of the machines of "Star Wars: Episode I—The Phantom Menace."

Like the spacecraft of the "Star Wars" trilogy, the machines of



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HYPERRIVE CORE

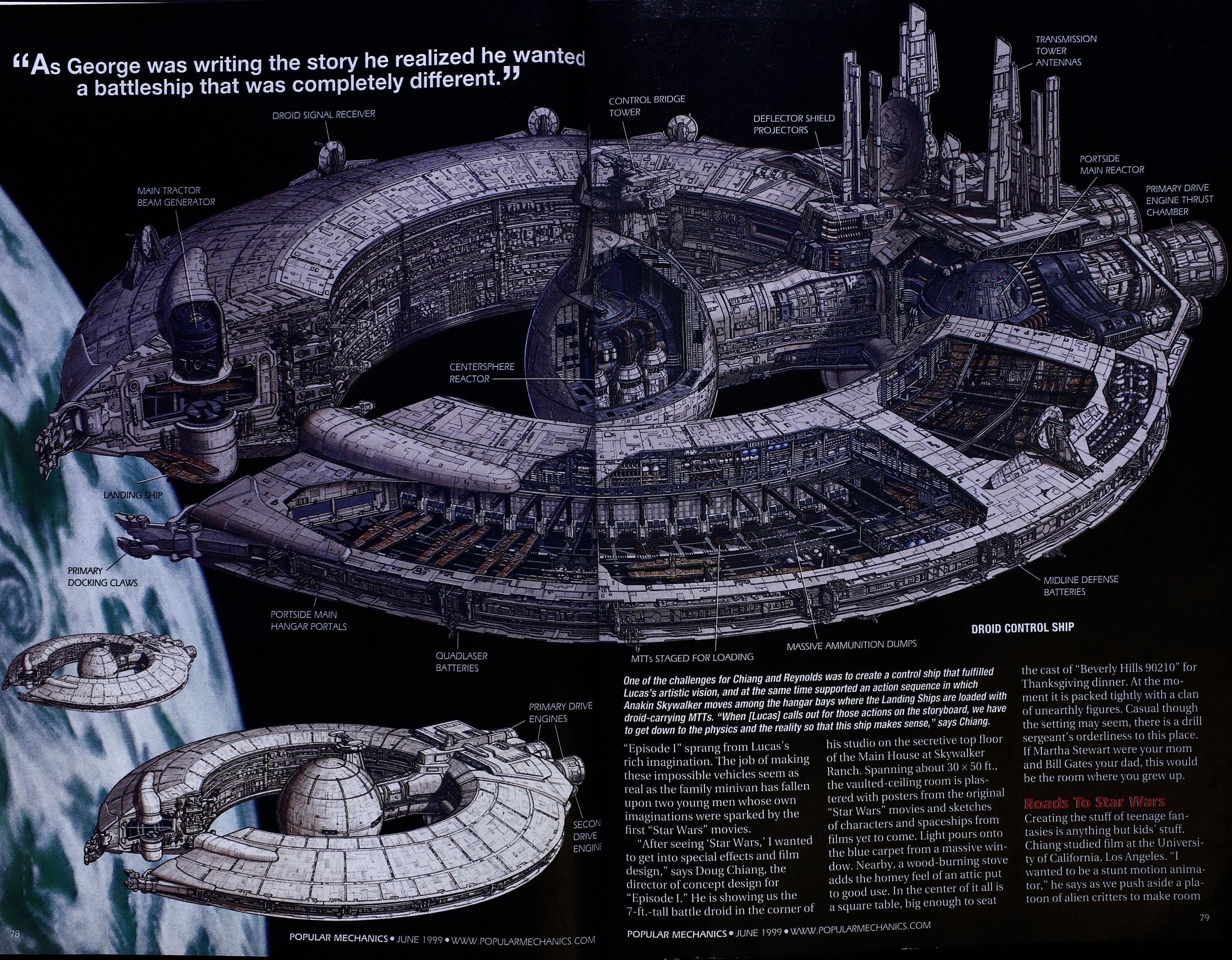
ROYAL STARSHIP

In an age when droids and automated factories do most of the work, the Royal Starship that carries the Naboo Queen Amidala on state visits distinguishes itself as the epitome of traditional craftsmanship. Even the purely decorative mirror as the chrome finish is hand-polished. The obsession with detail carries over to the hyperdrive core, which in addition to being a work of precision art, has been tweaked to be one of the best performing systems in the universe.

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"As George was writing the story he realized he wanted a battleship that was completely different."



the cast of "Beverly Hills 90210" for Thanksgiving dinner. At the moment it is packed tightly with a clan of unearthly figures. Casual though the setting may seem, there is a drill sergeant's orderliness to this place. If Martha Stewart were your mom and Bill Gates your dad, this would be the room where you grew up.

Roads To Star Wars

Creating the stuff of teenage fantasies is anything but kids' stuff. Chiang studied film at the University of California, Los Angeles. "I wanted to be a stunt motion animator," he says as we push aside a platoon of alien critters to make room

N-1 STARFIGHTER

Although the single-seat N-1 Starfighter has sharp teeth—including a laser cannon and proton torpedoes—it's main function is to serve as an honor guard for the Royal Starship, hence its partially chromed finish.

for my notepad. Animators speak in the language of line and color. So Chiang, a talented artist, honed his drawing skills. "It was easier for me to get a job in film through my art." Persistence also paid off.

He started his career as a key animator on the "Pee-wee's Playhouse" television series. By the time he was 37, Chiang had collected Academy Awards for "Death Becomes Her" and "Forrest Gump."

On "Episode I," Chiang worked closely with Lucas to develop almost everything you see except the actors. Sketches and models built in his attic studio were shipped to a second art studio in Leavesden, England, where they were turned into the sets that appear in the film.

Joining us is David West Reynolds, whose cutaways are fea-

tured on these pages and in a forthcoming book titled "Star Wars: Episode I Incredible Cross-Sections" (Dor-

ling Kindersley, Ltd., www.dkonline.com). Reynolds came to the film by a route that is itself the stuff of movies. By training, the 31-year-old is a vertebrate paleontologist and archeologist. He earned his doctorate at the University of Michigan, where he taught briefly.

"It's a natural step, archeology to working on 'Star Wars,'" he kids. In fact, it was. "I had done some work in North Africa, so I was familiar with Tunisia, where the original 'Star

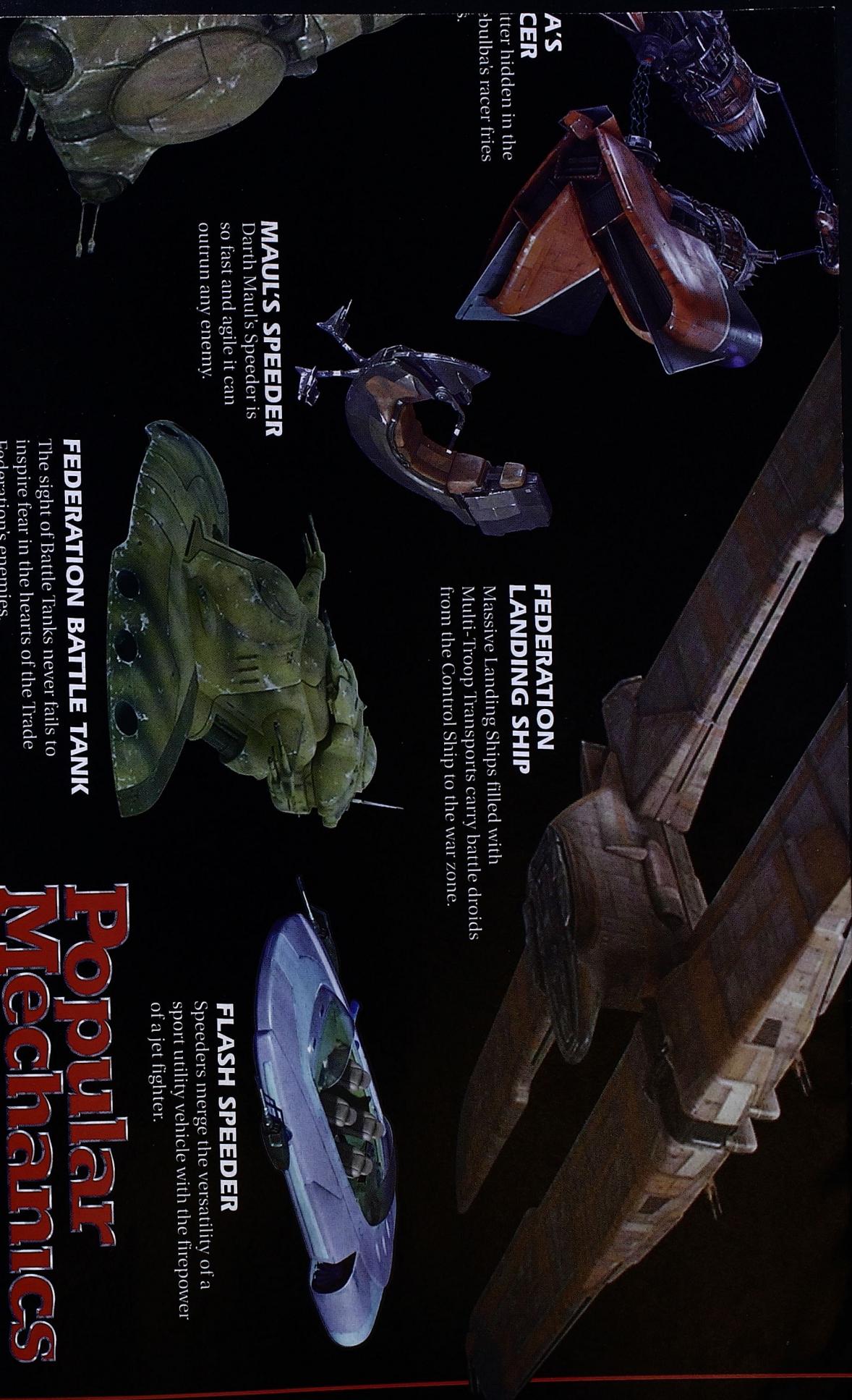
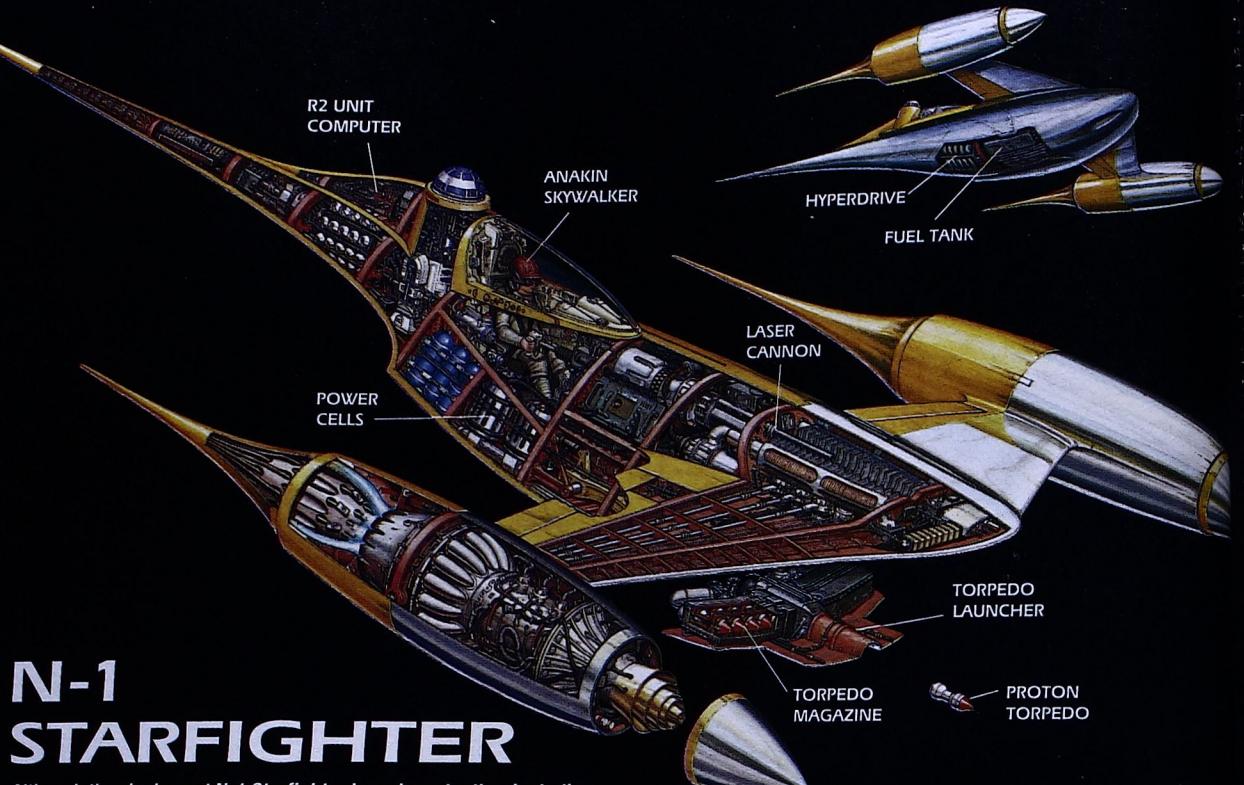
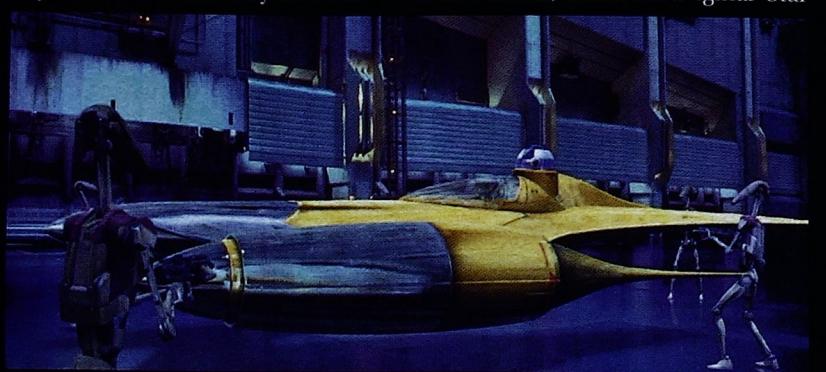
Wars' film was shot and where we later shot 'Episode I.'" He was asked to help relocate the filming site of the original movie. "We went in December 1995 for the first location scout for 'Episode I.' They took me with them as a guide." He stayed with the project, authoring a series of books for "Star Wars" fans.

After Lucas and Chiang decided what the machines of "Star Wars" should look like from the outside, it was largely up to Reynolds to make the interiors realistic enough to convince ticket and book buyers to snap on their reality suspenders.

The Control Ship

While Chiang and Reynolds don't need to observe the laws of physics as rigorously as NASA's rocket scientists, getting all the parts of an imaginary spacecraft to fit together can sometimes be just as challenging. And nowhere was that task as daunting as in the creation of the Droid Control Ship. For sheer size and drama it is the most spectacular craft in "Episode I."

Chiang casually tosses out a fact that is sure to be the tiebreaking answer in a future "Star Wars" trivia





DL SHIP
ontrols its
battle droids
from the

TH INFILTRATOR

The evil Darth Maul's Sith Infiltrator packs laser cannons and becomes invisible on his command.

ANAKIN'S PODRACER

Anakin Skywalker designed and drove his spectacular podracer when he was only 9 years old.

GIAN SPEEDER

Missile-launching Gian Speeders leap to the defense of Queen Amidala.

N-1 STARFIGHTER

The pilots who fly the single-seat Naboo Starfighters are the top guns of their day.



DROID STARFIGHTER

Droid Starfighters reconfigure themselves from flying (upper right) to fighting (main drawing) mode and sprout legs for planetary visits (below).

marathon: The Control Ship originally wasn't supposed to be in the film. "The design evolved after the fact," he says. The Trade Federation spacecraft were all going to be a similar shape. "As George [Lucas] was writing the story he realized he wanted a battleship that was completely different. That is why the [Droid] Control Ship evolved."

Chiang began the design process by applying a lesson he had learned from working with Lucas. "George likes simple shapes and simple forms," he says. "He really wanted to bring in a saucer-shaped vehicle." And so the Control Ship took

form, not as a derivative of a 1950s-era bicycle-wheel space station—which it closely resembles—but as a giant flying saucer.

Saucers might fly in 1950s science fiction movies, but 1990s fans demand more action. "As we got into it, we found it was very hard to tell direction, so George decided to put engines on it. I started playing around with making it a more exotic shape. George liked that idea. It slowly evolved where it became this doughnut, with the giant claw in the front to give it some personality."

Easy enough for Chiang to say. Now it was up to Reynolds to make it seem realistic enough to convince fans who would sit through the film a dozen times and study his cutaways with a magnifying glass. The first problem was that the location of the various hangars

in the Control Ship had to flow with the action in the film. "In this case it was very straightforward," says Reynolds. "Doug described how the ship functioned. I wanted to present a cutaway so you could follow the story." Two British illustrators, Hans Jenssen and Richard Chasemore, created the cutaways shown on these pages.

Reynolds needed to fill other spaces aboard the Control Ship

PHOTO BY JAMES A. LEE

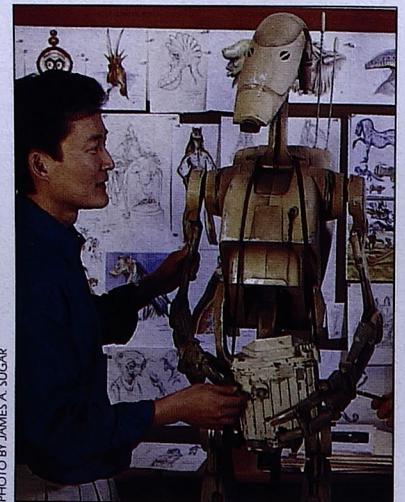


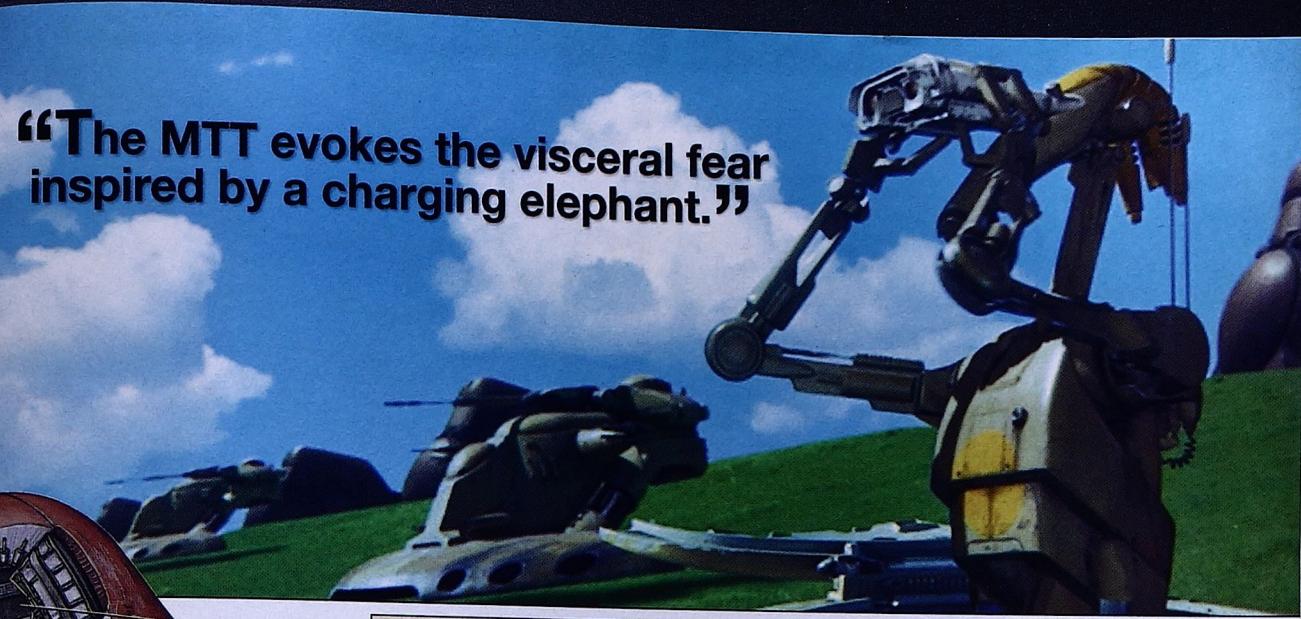
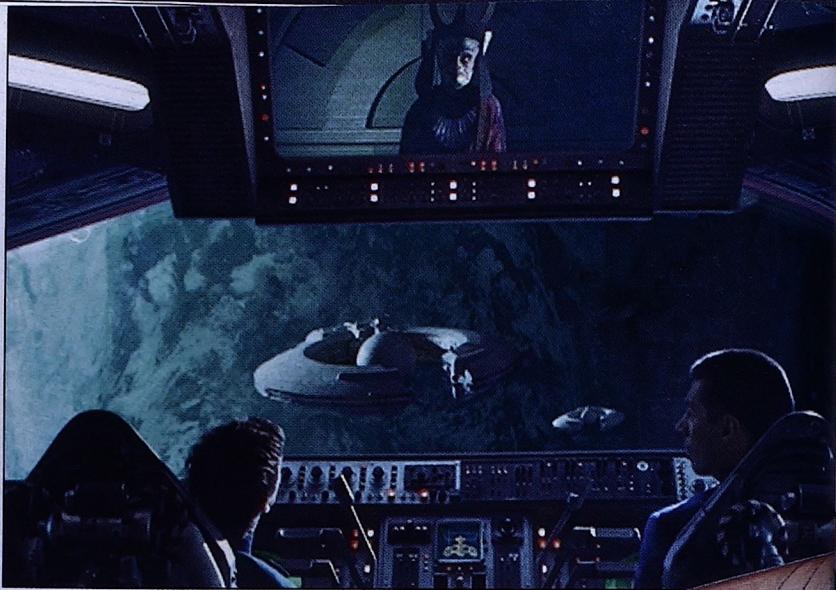
PHOTO BY JAMES A. SUGAR

Up close, a fully unfolded battle droid appears more amusing than menacing.

from his own imagination. "I asked [Chiang], 'What are these big bulges for?' And he said, 'They look cool.'" Not a lot of technical direction, but more than enough if you know the story line. The Control Ship, Reynolds explains, is converted freighter. Reynolds conjectured that to move smaller trading ships safely toward the massive structure the crew would have to use some sort of guidance mechanism, say a tractor beam. And so the bulges that Chiang had added to look "cool" became the housings for an imaginary tractor beam mechanism.

A Yellow Starfighter

The land vehicles in "Episode I" are the end product of the same balancing act that seeks to stretch the viewer's



"The MTT evokes the visceral fear inspired by a charging elephant."



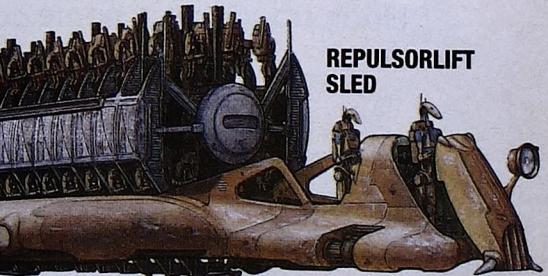
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Not all of the design decisions reflected a passion to remain faithful to the story line and the laws of physics. The Naboo Starfighter is yellow, for example, because Lucas wanted a yellow plane. And the Royal Starship looks like a piece of art deco jewelry because a particularly beautiful piece caught Chiang's eye while he was thinking about the ship's design. And so it went with everything you will see in the film: imagination, enhanced with just enough reality to make you a believer.

Although the first screening of

MULTI-TROOP TRANSPORT

The transport that brings battle droids to the front lines is intended to provide a realistic way to cross varied terrain and breach heavily defended fortifications.



"Episode I" is scheduled for well after this issue of PM has gone to press, we suspect the film will be as dazzling a success as the "Star Wars" movies of a generation ago. With a cast that includes the incredible machines we've just seen, we don't need to wish Lucas, Chiang and Reynolds good luck. The Force is with them.

PM

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STAR WARS

EPISODE I

THE PHANTOM MENACE™

TARSHIP
spect for the queen,
ship is the only fully
el in the Naboo fleet.

UNGAN SUB
ngan submarines
e grown like
shells, in under-
ter cities.

REPUBLIC CRUISER

One look at its cruisers
and you can tell that the
Old Republic has fallen

MULTI-TROOP TRANSPORT

Heavy-duty armored, the MTT transports
troops to the front lines.

SITH INFILTRATOR

The evil Darth Maul's Sith Infiltrator packs
laser cannons and becomes invisible on his
command.

DROID CONTROL SHIP

The Trade Federation controls its
Droid Starfighters and battle droids
with signals broadcast from the
Control Ship.

DROID STARFIGHTER

Shape-shifting Droid
Starfighters reconfigure
themselves for flying,
fighting and walking
on the surfaces of
alien worlds.

SEBULBA'S PODRACER

A flame emitter hidden in the
engine of Sebulba's racer fries
competitors.

MAUL'S SPEEDER

Darth Maul's Speeder is
so fast and agile it can
outrun any enemy.

FEDERATION BATTLE TANK

The sight of Battle Tanks never fails to

ANAKIN'S PODRACER

Anakin Skywalker design
and drove his spectacular
podracer when he was on
9 years old.

GIAN SPEEDER

Missile-launching Gian Speeder
to the defense of Queen Amidala.

N-1 STARFIGHTER

The pilots who fly the sin-
seat Naboo Starfighters a
top guns of their day.

FLASH SPEEDER

Speeders merge the versatility of a
sport utility vehicle with the firepow-
er of a jet fighter.

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STAR WARS™

EPISODE I

THE PHANTOM MENACE™

**QUEEN NABOO'S
NABOO STARSHIP**

of respect for the queen, Naboo Starship is the only fully functional vessel in the Naboo fleet.

BATTLE DROID

The droids are the land of Naboo; but as a post.

GUNGAN SUB

Gungan submarines are grown like seashells, in underwater cities.

REPUBLIC CRUISER

One look at its cruisers and you can tell that the

MULTI-TROOP TRANSPORT

SITH INFILTRATOR

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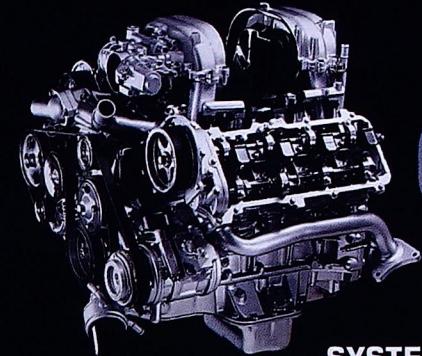
The pilots who fly the N-1 seat Naboo Starfighters as top guns of their day.

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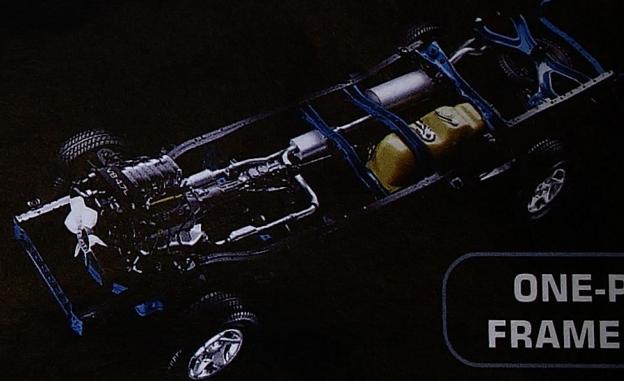
i FORCE V8

THE i-FORCE V8 PROPULSION SYSTEM CAN LAUNCH THE TUNDRA V8 4x2 FROM 0-60 IN 7.8 SECONDS, MAKING IT THE FASTEST FULL-SIZE PICKUP IN ITS CLASS.¹ HOWEVER, IF HAULING IS MORE OF A PRIORITY THAN SPEED, THE i-FORCE V8 ALSO GIVES THE TUNDRA UP TO 7,200 LBS. OF TOWING CAPABILITY.²

4-PISTON FRONT
DISC BRAKE
CALIPERS



IN ORDER TO CONSERVE WEIGHT AND IMPROVE CONTROL WHILE STOPPING, REVERSE-THRUST TECHNOLOGY WAS ABANDONED IN FAVOR OF 4-PISTON FRONT DISC BRAKE CALIPERS THAT STOP THE TUNDRA V8 4x4 UP TO 19 FEET SHORTER THAN ITS RIVALS.³



ONE-PIECE
FRAME RAIL

UNDERNEATH THE TUNDRA'S PROTECTIVE SHELL RESIDES FRAME STRONGER THAN THAT ANY ADVERSARY IN ITS CLAS

CONNECTING YOUR HOME

Hook up multiple home computers with new networking software.

BY KIM KOMANDO

► Have more than two

computers in your home? Want to network them together to share printers, files and Internet access, as well as play games? You're not alone. The Yankee

COMPUTERS Group, a computer consulting firm based in Boston, Mass.,

recently completed a survey which reports that 30.5 percent of PC owners are interested in home networking products.

Not too long ago, home networking meant buying a pricey network hub and spending the weekend running special cables from each computer to the hub. Or, you could run a cable directly from one computer to the other in a two-computer scenario. But be honest: Who wants to fiddle around running network cables all over

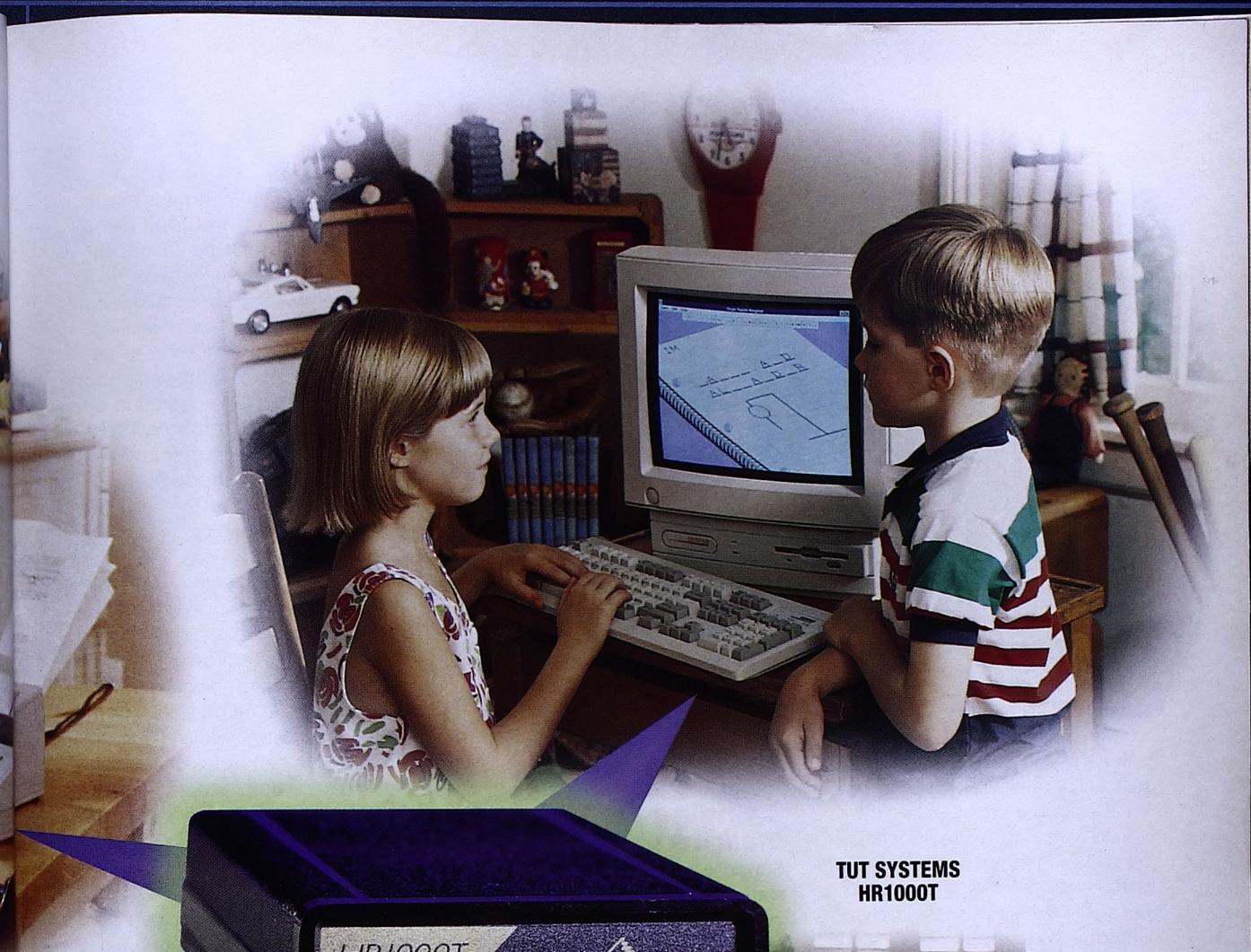
the house? Put your computer toolkit away. Here are some practical new products that eliminate the need for cables altogether, minimizing the pain-in-the-butt factor in setting up a home network.

Handy Dandy Phone Jack

One approach to cableless home networking is to hijack the phone wiring that already exists inside your home. Odds are, where there's a computer in your home, there's also a phone jack. Diamond Multimedia (800-468-5846; www.diamondmm.com), with its HomeFree Phoneline product, is leading this home networking initiative. The idea is simple. For about \$100, you get a starter pack that includes two special network interface cards (NICs—that's right, it's yet another computer acronym). What's special about NICs, at least by

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TUT SYSTEMS
HR1000T

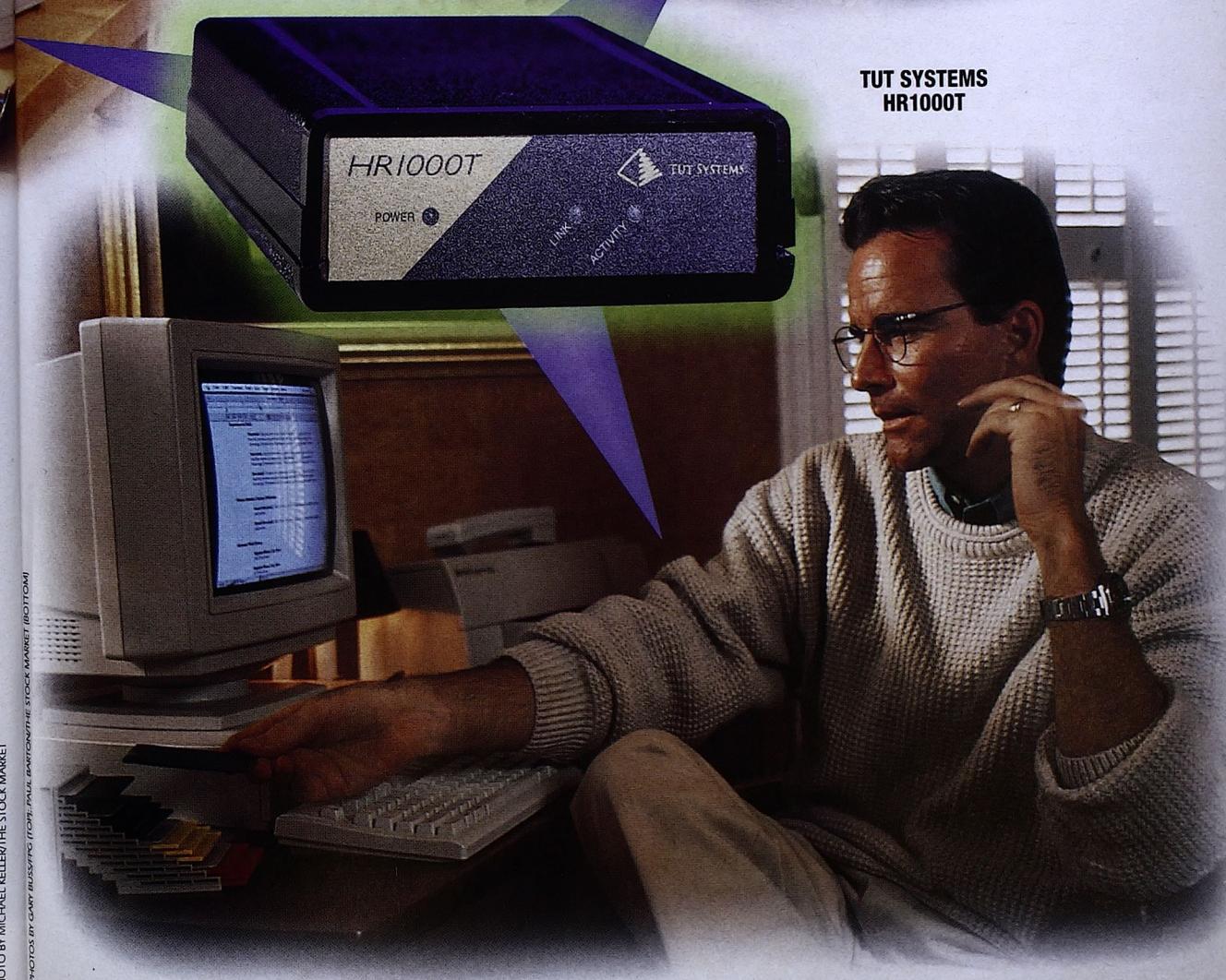


PHOTO BY MICHAEL KELLER/THE STOCK MARKET

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appearance, is that instead of traditional network connectors, the connectors on these cards look like regular phone jacks.

In essence, that's just what they are.

In a two-computer configuration, you install an NIC in each computer. Then you run a regular phone cable from each computer to the nearest phone jack. Just like that, you have a network. We had ours up and running in less than half an hour. The network doesn't interfere with your voice communications because it runs at a completely different frequency.

Basic printing functions and file sharing would work with these cards even if you didn't install any additional software. Windows 95/98 can handle that stuff on its own. However, the HomeFree Phoneline package also includes a copy of WinGate, software that allows multiple computers to share a single Internet connection. Trans-

lation: no more negotiations over who gets to be online. Both computers can be surfing the Web or sending and receiving e-mail at the same time.

Swinging For The Bleachers

Suppose you already have NICs installed in your computers or your computers have Ethernet networking built in. Tut Systems (800-684-2014; www.tutsys.com) offers a product similar to Diamond's called HomeRun. The big difference is that Tut offers an external adapter that allows you to connect any device with an Ethernet port to the network via your phone wiring. This is especially useful for all you Macintosh users.

In theory, you could try to get an

NIC designed for Windows to run in a Mac, but we wouldn't recommend it. Given that all current Mac models come with built-in Ethernet ports, the external HomeRun adapter makes more sense. With HomeRun, it's a snap to set up a Mac network using your phone wiring. You don't even need to open the case on your computer. These adapters sell at computer and electronics stores for around \$50.

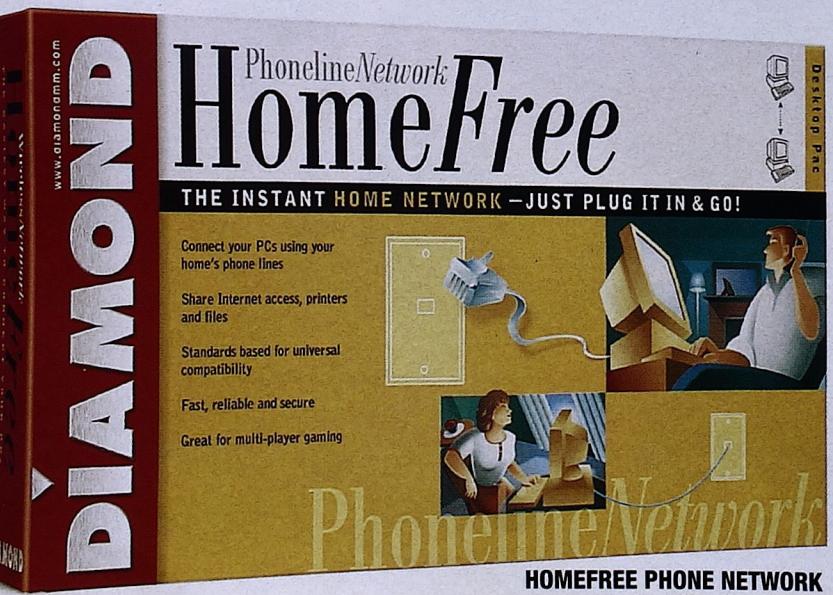
None of these solutions provide as fast a network as regular Ethernet cabling, but that's okay. The phone line solutions from Diamond and Tut both promise speeds of about 1Mbps. While that's only a tenth of the speed of the slowest Ethernet network that might be running at your office, it's still plenty fast for simple printer and file sharing. It's also about 20 times faster than the fastest analog modem, so it shouldn't slow down your Internet access either.

Plug And Share

If you want a boost in network speed, you can shift the network from your phone wiring to your electrical wiring with the PassPort line of products from Intelogis (877-468-3564; www.intelogis.com). These are similar to the phone line products: You connect each computer to a device that then plugs into a standard wall outlet. This system claims speeds of up to 1.6Mbps, roughly 50 percent faster than the phone line products.

One aspect of PassPort that can be seen as both an advantage and a disadvantage is that it connects to your computer through its printer port. The advantage is that you do not need to worry about installing any NICs. However, you will run into a problem (as we did) if you already have two devices, such as a scanner and a printer, attached to the printer port.

As a Band-Aid, you can attach your printer directly to one of the PassPort adapters instead of your computer. However, since printer-port scanners and the PassPort adapter both work as pass-through devices (meaning you can connect the device to your printer port and your printer to the device), we have



The image shows the retail packaging for the Diamond HomeFree Phoneline Network. The box is primarily red and yellow. On the left, the word "DIAMOND" is printed vertically in large white letters. To the right, the product name "HomeFree" is displayed in a large, stylized, serif font. Below "HomeFree", the text "Phoneline Network" is written in a smaller, italicized font. A central graphic shows a computer monitor connected to a wall outlet via a blue cord. The text "THE INSTANT HOME NETWORK - JUST PLUG IT IN & GO!" is printed above this graphic. To the right of the monitor, there are small icons for a printer and a scanner. At the bottom of the box, the text "HOMEFREE PHONE NETWORK" is repeated. The overall design is clean and modern.

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**BOSCH
PLATINUM+4**

"The connectors on these phone cards look like regular phone jacks."

our doubts about how well the two would behave attached to the same printer port. In the end, you could end up having to install a second printer port. Of course, if you only have a printer attached to your

wireless networking product like Proxim's Symphony (800-229-1630; www.proxim.com). Symphony provides good speed (1.6Mbps), plus the benefit of not having to worry about a single cable.

Proxim offers a wireless NIC for your PC, a wireless PC NIC for your laptop and a wireless modem that anyone on the network can access. (A wireless modem isn't physically connected to the computer, but the modem still needs to be plugged into a standard phone jack.)

The downside

is the cost—

wireless net-

work-

ing is con-

siderably more

expensive.

Proxim's

Symphony

modem

sells for about \$300,

the regular NIC sells for

about \$150 and the PC NIC

sells for about \$200.

SYMPHONY
modem
sells for about \$300,
the regular NIC sells for
about \$150 and the PC NIC
sells for about \$200.

FM

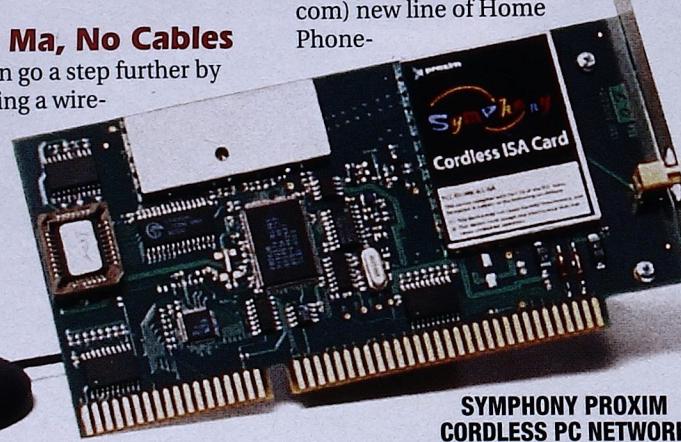


printer
port now, this
is all moot.

You can find the PassPort starter package for about \$200 in stores. It includes two PC connectors and one printer connector. Additional PC connectors sell for about \$90, and additional printer connectors run about \$70. The PassPort system is designed for Windows 95/98.

Look Ma, No Cables

You can go a step further by choosing a wire-



SYMPHONI PROXIM
CORDLESS PC NETWORK

For More On Technology

Check the Technology channel on the PMZone Web site at
<http://popularmechanics.com/popmech/elect/1HOMELECT.html>



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line Networking bundles. These packages include two computers that come pre-equipped with Diamond Multimedia's home networking package. Depending on which two computers you get in your bundle, list prices range from \$2500 to \$3900 for the whole shebang.

And more choices are on the way. Intel is the latest big name in the computer industry to announce its entry into home networking. The product uses the networking software built into Windows 95/98. And look for competing products from 3Com, Cisco Systems and Microsoft designed to connect household PCs and other digital devices in the near future. It's difficult to say who will win the networking war, but one thing is cer-

tain: If the thought of network hubs and complicated wiring has scared you away from connecting your home computers, you've got nothing left to fear.



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Technology

LEGO MANIA

Robotics are a snap with the new "intelligent" Mindstorms kits from Lego.

BY STEVE DITLEA
Photos by David Dewhurst

MIT senior Anthony Fudd's action-packed coin sorter (opposite), and his robot for picking Lego bricks off the floor (above), use standard Mindstorms hardware and software.

With so many video games and microprocessor-stuffed toys to choose from these days, it may be hard for children to focus their attention on those old-fashioned red and yellow and blue plastic model bricks that have been underfoot in American homes since 1961. We're talking about Lego robotics, of course, and now the Danish company that makes them is striking back by going high tech.

In short order, Lego has introduced the first widely available computer-controlled robot kit, become a prime supplier of "Star Wars Episode I" paraphernalia, and just opened its first U.S. theme park, Legoland—where technology rules behind the scenes (see "Love That Legoland," page 100).

And, oh yes, Lego is not just for kids anymore. The child-oriented firm found this out last fall when half the initial sales in the United States of its Mindstorms Robotics Invention System (intended for ages 12 and up) were to adults for their own use. That shouldn't be surprising since the \$200 kit (PC required) offers a unique mix of mechanical and computing challenges for the savvy hobbyist.

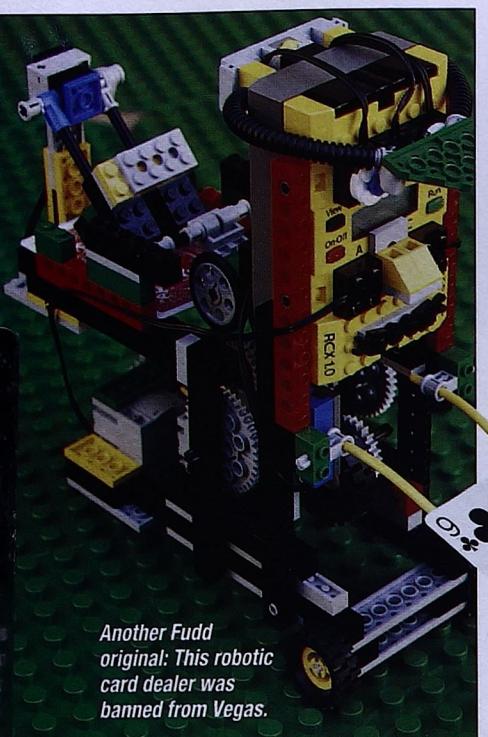
The origin of Mindstorms (www.legomindstorms.com) goes back to research at the Massachusetts Institute of Technology, with which Lego has been working since 1984 to link computer programming to its building pieces. In fact, the newest Lego line takes its name from *Mindstorms*, a pioneering book on computers and children's education by MIT professor Seymour Papert.

In 1994, MIT Media Laboratory research scientist Fred Martin created the Programmable Brick, a miniature computer for children to build into their Lego models. While the Mindstorms system's hardware and software have been completely redesigned by Lego engineers, Martin is considered the godfather of these robotics kits. "Lego Mindstorms is the first product that allows anyone to design and build a robot inspired by their own imagination," says Martin. "The adults who are buying Mindstorms wanted to do this when they were kids, but no such product existed. So now they're just fulfilling childhood fantasies."

At the heart of the Mindstorms system is a yellow-and-gray plastic brick about the size of a bar of soap, called the RCX. When powered by six AA batteries, its Hitachi H8 processor can receive inputs from up to three sensors. The Robotics Invention System includes touch and light sensors, and temperature and rotation sensors are also available. The unit then processes these inputs according to program instructions, resulting in output to up to three motors. Though the RCX comes

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"I have my own 30-year-old Lego set that I won't let my son mix in with his pieces."



Another Fudd original: This robotic card dealer was banned from Vegas.

with a few elementary programs of its own, hobbyists can create more elaborate behaviors by composing programs on a PC in a visual programming environment that resem-

For More On Technology

Check the Technology channel on the PMZone Web site at <http://popularmechanics.com/popmech/elect/1HOMELECT.html>

bles stacks of LEGO bricks, then downloading them to the RCX via wireless infrared signals. Choose the right commands and you can create a robot that turns around when it bumps into obstacles or is drawn to light like a moth.

After programming the RCX for your robot's intended actions, you must still use LEGO beams and gears to build the model that will embody this behavior. The pieces are mostly the gray and black architectural and me-

chanical ones from the LEGO Technics line for 7- to 16-year-olds (of the more than 700 pieces in

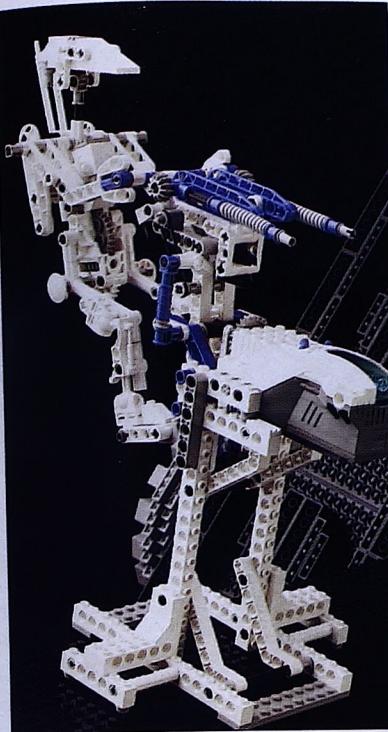
the Mindstorms Robotics Invention System only a handful resemble the traditional colorful bricks in the LEGO System for 3- to 13-year-olds).

In expert hands, Mindstorms can produce mind-boggling results.

Among today's top LEGO designers is a senior in MIT's architecture department, Anthony Fudd, 27, who works as a consultant to LEGO. His latest masterpiece (created at the request of POPULAR MECHANICS creative director Bryan Canniff, whose 4-year-old son is always leaving LEGO pieces out on the floor) is a wheeled robot that crisscrosses a room scanning for LEGO bricks. When it finds one of a specified color, the automaton picks it up with a pair of pincers and returns it to a pile in one corner of the room.

Other Fudd originals: an electro-mechanical coin sorter (identifying coins' width by tenth-of-a-second differences in input from touch sensors) and a working copying machine (which lowers a pen to paper whenever it detects a dark area on an original document). The pieces and software he uses are LEGO standard issue, so anyone can duplicate his models.

Some technically minded enthu-



The Droid Developer Kit's battle droid from "Star Wars—Episode I" (above). At Legoland (right), Albert Einstein and Mindstorms' paper copier and PC built from LEGO bricks.



puter (maginet.net/~twdow/mindstorms.html).

At 40, Nelson considers himself typical of adult Mindstorms fans. "I have my own 30-year-old LEGO set that I won't let my son mix in with his pieces," says this LEGO lifer whose interest was renewed by his child. Between his own boyhood and that of his son, Nelson's construction set gathered dust in a closet, a common occurrence.

"There's even a name for it," he adds. "We call it the Dark Ages."

Helping to dispel the Dark Ages are LEGO's latest additions to the Mindstorms line. To extend the robotic system's accessibility to 9-year-olds, there's an all-new easy-to-use Scout microcomputer at the heart of the \$150 Robotics Discovery Set (no PC required).

And then there's the new Droid Developer Kit (\$100), with parts and plans for building classic or new "Star Wars" droids that move, chirp and respond to their environment. "There's a natural overlap," he explains. "LEGO Mindstorms has attracted the robotics community. If you like robots, you probably like 'Star Wars.'"

May the parts be with you!

PM



Popular Mechanics

Love That Legoland

Oh, the Legos! They're everywhere at this new theme park located in Southern California. With other amusement parks in the area such as Disneyland and SeaWorld, Legoland is unique in its own right. And although both Denmark and England have already opened parks with the same name and concept, LEGO spokesperson John Dion believes the park in Carlsbad, Calif., has a completely different energy to it.

According to LEGO, 30 million LEGO bricks were used to build the 128-acre park—20 million of which were used for Miniland, where you'll find several LEGO cities, including New York, San Francisco, Washington, D.C., and New Orleans. Other

LEGO attractions include a voluptuous movie star in a low-cut LEGO dress stopping traffic (a little bit of the European flavor is apparent).

Most importantly, Legoland is completely interactive, with tons of things to do for the little ones as well as the grown-ups. Other areas include the Maniac Zone, Fun Town, Duplo Village and Castle Hill—and even a Mindstorms pavilion, where you can build your own robotic creations and let them roam.

Other interactive attractions include a driving school and skipper school for children. So go and play for the day—it's definitely an experience.

—Tobey Grumet

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MUSIC INSTRUCTION/INSTRUMENTS

Last Page

Think It's New? Think Again!

BY MARY SEELHORST

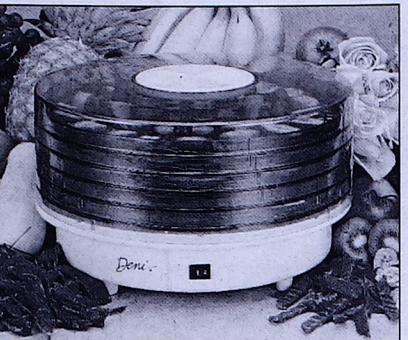
PRESENT

All dried up and nowhere to go: You can dry your own food and never leave the house with new home food dehydrators.

► Americans

have recently whetted their appetite for dried foods, and made home food dehydrators best sellers on TV shopping networks.

Why do it yourself when you can buy all manner of dried foodstuffs—from the common raisin to the exotic (at least where we live) papaya? If you believe the infomercials, doing it yourself can ensure no preservatives or salt are used, and is less expensive. But a recent



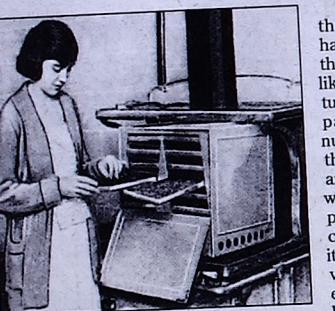
Good Housekeeping test determined that drying foods at home was not less, but more expensive, at least when you have to purchase the food you are drying. The only exception was jerky—even when you buy the meat, it is less expensive to cure it at home.

So unless you grow (or hunt) your own, you might be better advised to just head to the local health food store.

PAST

Dry goods: In a grow-your-own era, food dehydrators were practical and efficient.

FOOD DEHYDRATION AT HOME WITH SIMPLE APPARATUS



The Dehydrator Used on Top of Ordinary Gas Stove: This Type Has Six Shelves, Accommodating 12 Trays of Different Foods to be Preserved

Preservation of foods in the home by dehydration has been made possible by the production of an oven-like arrangement manufactured by a New York company. In operating, a number of trays containing the food to be dehydrated are placed in the apparatus, while underneath these is a pan, or humidifier, having a certain amount of water in it, and which has been previously heated to the proper temperature. From the humidifier, the moist heat rises, passes through and over the different trays, and then out through vents at the top. After a period of six to eight hours, depending on the kind of food used, the contents of the trays are dehydrated, and can be kept in containers for an indefinite length of time without spoiling. The containers used need not be sealed, as the food in its new state does not lose any nourishing values even though exposed to the atmosphere.

April 1922 issue

living on farms or in rural areas, home food preservation was an essential activity.

POPULAR MECHANICS often reported on innovations to make farm life easier, and this 1922 food dehydrator was one of them.

Canning and drying were important activities. Many farm families used smokehouses, or even specialized dry houses specifically built to preserve meats, fruits and vegetables. Yet many nonfarm families had large gardens but no room for such specialized outbuildings. For them, such a home dehydrator may have been an economical and efficient choice.

This PM dehydrator used a natural gas stove to provide the heat to dry foods. A pan of water at the bottom created moist heat. Although PM does not explain the rationale for adding moisture in a dehydrator, we can attest to the benefit of moisture after accidentally creating what can best be described as "tomato chips" in the oven. (And yes, we grow our own.)

Today's models are most often self-contained electric units, thus overcoming the biggest drawback to drying foods in the oven—heat buildup.

So before you click over to your favorite infomercial and buy a dehydrator, take a dry-eyed look at your dehydration situation and think again.

FM

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